THE LINE OF Proportion or Numbers,

Commonly called

GUNTER's LINE

MADE EASIE:

By the which may be Measured all manner of *Superficies* and *Solids*, as Boards, Glass, Pavement, Timber, Stone, &c.

ALSO,

How to perform the same by a Line of Equal Parts, drawn from the Centre of a *Two-Foot Rule*.

Whereunto is added

The Use of the Line of Proportion Improved: Whereby all manner of *Superficies* and *Solids* may both exactly and speedily be Measured, without the help of Pen or Compasses, by Inspection, looking only upon the *Ruler*.

By *WILLIAM LEYBOURN*.

LONDON, Printed for *Hannah Sawbridge* at the *Bible* on *Ludgate Hill*. 1684.

LICENCED,

Novem. 9. 1666. Roger L'Estrange.

TO THE READER.

THE *Line of Proportion or Number, commonly called (by Artificers)* Gunter's Line *hath been discoursed of by several Persons, and variously applyed to divers uses; for when Mr.* Gunter *had brought it from the Tables to a Line, and written some uses thereof, Mr.* Wingate *added divers Lines of several lengths, thereby to Extract the Square or Cube Roots, without doubling or trebling the distance of the Compasses. After him. Mr.* Milbourn, *a* Yorkshire *Gentleman, disposed it in a Serpentine or Spiral Line, thereby enlarging the divi-*

sions of the Line. Again, Mr. Seth Patridge *contrived two Rulers, to slide one by the side of the other, having upon them two Lines of one length; which exactly and readily performeth all Operations wrought thereby, very exactly and speedily, without the help of Compasses.*

Now whatsoever all the forementioned Contrivances will perform, I have here shewed in this Manual; and so ordered the Line; that it will perform the Work without Compasses, by Inspection, looking onely upon the Ruler. And thereby may be measured (let the Line be of what length soever) not one; Board, Glass, Timber, and Stone, *but also all manner of* Hangings, Pavements, Wainscots, Plaistering, Tyling, Brick-Work, *&c. To all which Uses I have particularly applied it, as will appear by several Instances in all the foremention'd Particulars; and the rather, because this Treatise may be beneficial*

To the READER.

ficial and useful as well to Gentlemen and others, who at this time may have, more than ordinary occasion to make use thereof, in the Rebuilding of the Renowned City of London, *as to Artificers themselves, for whose sakes chiefly it was intended.*

Vale.

ADVERTISEMENT.

IF any Gentleman, ſtudious in the Mathematicks, have, or ſhall have occaſion for Inſtruments thereunto belonging, or Books to ſhew the Uſe of them, they may be furniſhed with all ſorts, uſeful both for *Sea* or Land either in Silver, Braſs, or Wood, by *Walter Hayes*, at the *Croſs-Daggers* in *Moor-fields*, next door to the *Popes-head* Tavern; where they may have all ſorts of Maps, Globes, Sea plats, Carpenters Rules, Poſt and Pocket-Dials for any Latitude, Steel-Letters, Figures, *Signs*, Planets, or Aſpects, at reaſonable Rates.

How

How to Measure BOARD and TIMBER BY THE Carpenter's Plain Rule.

ALL manner of Superficial and Solid Measures may be measured the most absolute and artificial ways that are yet known, by the Precepts and Examples in this Book delivered: But although every Capacity may not attain to the knowledge and understanding thereof, I thought good here to incert the Use of that Rule which is commonly made and sold, and which every Artificer continually carries about him.

Its Description.

I. *Of the* FORE-SIDE.

It consisteth of two flat Sides, one of which, towards either edge thereof is divided into 24 Equal parts, called Inches, and numbred by 1, 2, 3, 4, and so forth, to 24 at the end thereof. Every one of the Parts or inches is again divided into two equal Parts, by lines about half the length of the other, representing half Inches; and every of those Half-inches is divided into two other equal parts, called Quarters of Inches; and each of those again into two other equal Parts, called Halfquarters of inches: So that each Inch is divided into eight equal Parts, representing inches, Halves, Quarters, and Half quarters.

Both the edges on the one side of the

the Rule are thus divided and numbred, onely where 24 ſtands at one end of the line on one edge, there 1 ſtands on the other edge; ſo that, which end of the Rule ſoever you meaſure with, you may count your number of Inches and Parts right, without turning of the Rule.

II. *Of the* BACK-SIDE.

On the other ſide of the Rule you have two other Lines or Scales drawn near to the edges of the ſame ſide. One is called *The Line of Board-meaſure*, the other, *The Line of Timber-meaſure*. At the beginning of either of theſe Lines you have a little Table of Figures, the one for *Board*, the other for *Timber* or *Stone*.

The Line or Scale of *Board-meaſure* begins at 6 towards your left hand, and ſo goes on to 36, ending

just 4 inches short of the other end of the Rule; but sometimes this Line is continued up to an hundred, but not often; and then it goes nearer to the end of the Rule, namely, to within an inch and an half of the end thereof. At the beginning of this Line there is a small Table, from 1 to 6 inches, which shews (in Figures) the quantity of the length of a Foot of any Board from 1 inch broad to 6 inches broad; and then the Divisions supply the greater Breadths.

On the other edge, on the same side, you have the line or scale of Timber-measure This Scale begins at 8 and an half, and so goes on (by Divisions) to 36, towards the other end of the Rule, namely, 36; ending within almost an inch and half of the Rules-end. To this Scale also there belongeth a Table, which standeth at the beginning of the line, and goes from 1 Inch to 8 inches, and

gives

gives the quantity of the length of a Foot of any Timber under 8 Inches square in Figures, as the other did for Board from 1 to 6. And these are called *The Tables of Under-Measure.*

The Table for

UNDER-BOARD-MEASURE.

1	2	3	4	5	6
12	6	4	3	2	2
0	0	0	0	4	0

The Table for

UNDER-TIMBER-MEASURE.

1	2	3	4	5	6	7	8
144	36	16	9	5	4	2	2
0	0	0	0		9	11	3

Thus much for the Description of the

the lines upon the Carpenters Plain Rule. Now for

Their Use.

I. *Of the Fore-side, or Side of Inches.*

This Side is onely to measure the length and breadth of any thing to be measured, in Inches and Parts; the manner of doing whereof is natural to every Man: for, taking the Rule in the left hand, apply it to the thing to be measured; so have you the length, breadth, or thickness of the thing desired. But,

II. *Of*

II. *Of the Back side.*

AND,

I. *Of the Line of Board-measure.*

PROBL. I.

The breadth of any Board being given, to find how much thereof in length will make a Foot square

Look for the number of inches that your Board (or Glass) is broad, in the Line of Board-measure; and the number of inches and parts of an inch, which stand against that on the other side of your Rule, is the quantity of inches that will make a Foot square of that Board, or Glass, or what other thing soever it be to be measured.

Example

Example 1. *There is a Board or Plank that is 9 Inches broad, how much of that in length will make a Foot square?*

Look for 9 inches upon the Line of Board-measure (which you ſhall find at the Figure 9 upon the ſame line) and juſt againſt that, on the other ſide of your Rule, you ſhall find 16 inches, which ſhews that every 16 inches of that Piece in length will make a Foot ſquare.

Example 2. *A Pane of Glaſs is 22 inches broad, how much thereof in length will make a Foot ſquare?*

Look for 22 inches in the line of Board-meaſure, and right againſt it (on the other ſide of your Rule) you ſhall find 6 inches and almoſt an half; and ſo much in length of that breadth will make a Foot ſquare.

Example

Example 3. *If any plain Superficies be 30 inches broad, how much thereof in length will make a Foot ſquare?*

Seek for 30 inches in the line of Board meaſure, and right againſt it, on the other ſide of the Rule, you ſhall find 4 inches and ⅘ that is 4 inches and 4 fifth parts of an inch.

Example 4. *If a Board be 9 inches and an half broad, how much thereof in length will make a Foot ſquare?*

Seek 9 inches and an half in the line of Board meaſure, and againſt that, on the other ſide of the Rule, you ſhall find 15 inches and about 1 ſixth part of an inch, to make a Foot ſquare.

☞ *NOTE.* All theſe Examples might be performed otherwiſe by the line; for if you take the Rule in

in your left hand, and apply the end thereof, noted with 36, to the end of the Superficies, the other edge of the Superficies will shew how many Inches, Halves, and Quarters will make a Foot square. This needs no Example.

PROBL. 11.

The length and breadth of a Superficies being given, to find how many Square Feet are therein contained.

By any of the ways (before taught) find how much of the breadth given will make a Foot square; then run that length from one of the ends of the Superficies as often as you can, and so many square Feet is there in that Superficies.

Example

Example. *A Board is 9 Inches broad and 15 Foot long; how many ſquare Feet are therein contained?*

By the firſt Example you find that at 9 inches broad, 16 inches in length do make a Foot: Wherefore take 16 inches of your Rule, and run that length along the Board from one end thereof and you ſhall find that length to be contained in the Board of 15 Foot long, 11 times, and 4 inches over, which is $\frac{1}{4}$ of a Foot; ſo that the Board of 15 Foot long and 9 inches broad, contains 11 Foot and one Quarter. The like of any other.

II. *Of the Line of timber-meaſure.*

PROBL. I.

The Square of any Piece of Timber at the end thereof being given, to find how much of that Piece in length will make a Foot ſolid.

The

The Uſe of the line of Timber-meaſure, is in all reſpects the ſame as that of Board-meaſure; for knowing the Square of your Piece of Timber at the end thereof, you have no more to do than to look for the quantity of the Square thereof in the line of Timber-meaſure, and right againſt it, on the other ſide of the Rule, you have the quantity of inches that will make a Foot ſolid of that Piece.

Example 1. *A Piece of Timber is 10 Inches ſquare, how much thereof in length will make a Foot ſolid?*

Look for 10 inches in the line of Timber-meaſure, and right againſt it, on the other ſide of the Rule, you ſhall find 17 inches and ſomewhat above a quarter of an inch; and ſo much of that Piece in length will make a Foot ſolid.

Example

Example 2. *If the Square of a Piece of Timber be* 21 *Inches, how much thereof in length will make a Foot ſolid?*

Seek 21 Inches in the Line of Timber-meaſure, and againſt it you ſhall find, on the other ſide of the Rule, almoſt 4 inches; and ſo much in length will make a ſolid Foot of Timber.

Note 1. If Timber be broader at one end than at the other, the uſual way is to add both ends together, and take half thereof for the true Square: but if the difference be very much this way is erroneous, though for the moſt part practiſed.

Note 2. Alſo for Round Timber, the uſual way is to girt it about the middle with a ſtring, and take a fourth part thereof for the ſquare; this alſo is erroneous: Therefore, for ſuch as deſire

desire curiosity and exactness, let them repair to the Rules in this Book delivered for that purpose, where they may receive ample satisfaction.

Concerning the Tables at the beginning of the Lines of Board and Timber-Measure.

The Table of Board-measure gives the length of a Foot square of any Board under 6 inches broad; therefore by the Table there set you may find that.

		Inches broad.	Foot.	In.	Parts.	
If a Board be	1		12	0	0	will make a Foot square,
	2		6	0	0	
	3		4	0	0	
	4		3	0	0	
	5		2	4	0	
	6		2	0	0	

By this small Table you may see, that a Board of 4 inches broad will require 3 Foot thereof in length to make

make a Foot ſquare. Alſo, a Board of 5 inches broad will require 2 foot. 4 inches and 4 fifth parts of an inch.

The Table of Timber meaſure gives the length of a Foot ſolid of any piece of Timber or Stone whoſe ſquare is under 8 inches: Wherefore, by the Table at the beginning of the line of Timber meaſure, you may find that

If a piece of Timber be	Inches Square.	will make a Foot ſolid.
1	144 0 0	
2	36 0 0	
3	16 0 0	
4	9 0 0	
5	5 9 0	
6	4 0 0	
7	2 11 0	
8	2 3 0	

By this Table (which is the ſame in effect with that which ſtandeth at the end of the Line of Timber-meaſure) you may ſee that a piece of Timber, that is 4 inches ſquare requires 9 Foot in length to make a ſolid Foot: Alſo a piece of 5 inches ſquare, requires

The Authors Advertisement.

IF any Gentleman, or other Person, desire to be instructed in any of the Sciences Mathematical, as *Arithmetick*, *Geometry*, *Astronomy*, the Use of the *Globes*, *Trigonometry*, *Navigation*, *Surveying of Land*, *Dialling*, or the like; The Author will be ready to attend them at times appointed.

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You may hear of him where these Books are to be sold.

THE LINE OF Proportion or Numbers, Commonly called GUNTER'S LINE MADE EASIE.

WHat this Line is, and how to make it, is best know to those who make Mathematical Instruments; but the Uses of it are so general, that all sorts of Men of what Faculty soever, may apply it to their particular Uses; though it more immediately and particularly concerns such Artificers, whose Employment consists in Mensuration:

as *Carpenters*, *Joyners*, *Maſons*, *Bricklayers*, *Painters*, *Glaſiers*, and ſuch like; for that all kind of Menſurations, either *SUPERFICIAL*, as *Board*, *Glaſs*, *Pavement*, *Tyling*, &c. or *SOLID*, as *Timber*, *Stone*, *Pillars*, *Pyamids*, &c. are by this Line moſt eaſily, ſpeedily, and exactly performed: For whatſoever thing, concerning Meaſure, that may be performed by Arithmetick, this Line will do exactly, and much ſooner, as by the working of the ſeveral Rules in Arithmetick, by this Line ſhall be plainly made appear.

CHAP. I.

NUMERATION upon the Line

BEfore I ſhew you how to number upon the Line, it will be neceſſary to let you underſtand how the Line

Line is dividied and numbred, as alſo what thoſe Diviſionsand Numbers ſet to them upon the Ruler, do ſignifie.

Know therefore, that the Line of Numbers begins at the Figure One, and ſo proceeds ſucceſſively from 1, to 2, 3, 4, 5, 6, 7, 8, 9; and then on farther, by 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, at the end of the Line.

The firſt 1, which ſtandeth at the beginning of the Line, repreſenteth the *One tenth part* of any Unite or Integer, as one tenth part of a Foot, One tenth part of a Yard, Ell, Perch, Mile, *&c.* Or it may ſignifie, One tenth of a Year, Month, Hour, *&c.* Or the one tenth of a Pound, Shilling, or Penny, *&c.* Or the one tenth parts of any thing either in Number, Weight, Meaſure, Time, or the like. The Figure 2, ſignifies Two tenth parts of any thing: The Figure 3, Three tenth parts: The Figure 4, Four tenth

parts, &c. till you come to the second 1, which ſtandeth in the middle of the line; which 1 ſignifieth One whole Unite or Integer, as One whole Foot, Yard, Perch, &c.

Now the other intermediate Diviſions, thoſe which ſtand between the Figures 1 and 2 (which are in number ten) do repeſent (each of them) one hundredth part of one Unite or Integer; ſo the firſt Diviſion beyond the figure 2, repreſents 1 hundred parts of the Integer; the ſecond Diviſion, 1 hundred parts of the Integer, and ſo on: the figure 2 repreſenting 20 hundred parts of the Integer; and the next Diviſion beyond 2, is 21 hundred parts, and ſo on, till you come to the Figure 1 in the middle of the Line, which repeſenteth one whole Integer. The Figure two ſignifieth two whole Integers; the Figure 3, three whole integers, and ſo on till you come to 10 at the end of the Line, which

ſig-

ſignifieth ten whole Integers; and the intermediate Diviſions, which ſtand between 1 and 2 in the midle of the line, are (every of them) tenth parts of the Integer. So the Rule contains ten whole Integers, every of which is divided into ten parts.

But if upon the line you would count Numbers of more places than two (which are all Numbers above 10) then the 1 which is at the beginning of the line, muſt be accounted one Integer; and the 1 in the middle of the line, ten Integers; and the 10 at the end, will be 100 Integers.

But yet farther, If upon the line you would expreſs Numbers of more places than three (which are all Numbers above 100) then the 1 at the beginning of the line is to be accounted ten Integers, the 1 in the middle a hundred Integers; and the 10 at the end of the line, 1000 Integers.

And if you proceed yet farther; then the 1, at the beginning, muſt be accounted for a hundred Integers; that in the middle, a thouſand; and the 10 at the end of the Line, for 10000, ten thouſand Integers.

In this manner you might proceed farther, by counting the firſt 1 for 1000, 10000, *&c.* Integers: but to four places is ſufficient; which by a Rule of a competent length (as of two Foot) any queſtion concerning Meaſuring, may be by one exactly enough performed.

The Diviſions and Numbers on the Line being thus explained, it reſteth now to ſhew you how to find that Point upon the Line, which ſhall repreſent any number propoſed: and that I ſhall ſhew you in theſe Propoſitions following, which may fitly be called

NUMERATION.

PROP

PROP.

A whole Number, consisting of two, three, or four places, being given; to find the Point upon the Line which representeth the same.

NOTE, Let your Number given be of how many places soever; for the first Figure of your Number, you must take the same Figure upon the Line: For the second Figure in your Number, take the Number thereof on the grand (or larger) intermediate Divisions on the Line. For the third Figure in your Number, take the Number thereof on the smaller intermediate Divisions on the Line. And for your fourth Figure, you must find its place by estimation.

Example I. *Let it be required to find the place of* 15 *upon the Line.*

For your first Figure 1, count the 1in

the middle of the line; then for the 5, which is your second Figure, count five of the grand (or larger) intermediate Divisions upon the line, and that point is the very place upon the line representing 15.

Note, That every fifth of the grand intermediate Divisions is drawn forth with a longer Line than the rest, for ease in counting.

Again, *To find the place upon the Line representing* 37. For your first Figure, 3 count the Figure 3 upon the line; then for the 7, count 7 of the intermediate Divisions; and that Point is the place upon the Rule representing 37.

Example 2. *Let it be required to find the place of* 134 *upon the Line.*

For your first Figure 1, count 1 upon the Line; for your second Figure 3, count three of the grand Divisions; and for the third figure 4, count 4 of the smallest intermediate Divisions, and that very point is the place

upon the Line repreſenting 134.

Again, *To find the place repreſenting* 308. For your firſt Figure 3, count the three upon the Line; for your ſecond Figure 0 (which is a Cypher) count none of the grand Diviſions; but for your laſt Figure 8, count 8 of the intermediate Diviſions, and that Point ſhall be the place upon the Line repreſenting 308.

Example 3. *Let it be required to find the place of* 1350. For your firſt Figure 1, take 1 on the middle of the Line: For your ſecond Figure 3, take the Figure 3 upon the line upwards; for the 5, count five of the Grand intermediate Diviſions; and that is the place of 1350.

Again, *To find the place of* 1626. For you firſt Figure 1, count the 1 on the middle of the line; for your ſecond Figure 6, count the Figure 6 upon the line upward; then for your third Figure 2, count two of the

grand divisions; and for your last Figure 6, estimate six tenth parts of the next grand Division (which is something more than half the distance, because 6 is more than half 10,) and that is the Point upon the Line representing 1626.

Note, By these Examples last mentioned, you may perceive, that the Figures, 1, 2, 3, 4, 5, 6, 7, 8, 9, do sometime signifie themselves alone, sometimes 10, 20, 30, *&c.* sometimes 100, 200, 300, *&c.* as the Work performed thereby shall require. The first Figure of every Number is always that which is here set down, and the rest of the Figures are to be supplied according as the nature of the Question shall require.

And by this variation and change of the Powers of these Numbers from 1 to 10, or 100, or 1000, any Proportion, either Arithmetical or Geometrical, may be wrought. One whereof

whereof I will insert, for your better exercise of numbering on the Rule; by the often practice whereof, you will find the Work facile and delightful; which shall be this following.

PROP. 2.

Having two Numbers given to find as many more as you please, which shall be in continual proportion one to another, as the two Numbers given were.

FOr the working of this Proposition, this is *THE RULE*. Place one Foot of the Compasses in the first given Number on the Line, and extend the other Foot to the second given Number; then may you turn the Compasses from that second Number to a third, from that third to a fourth, from that fourth to a fifth, a sixth, a seventh, *&c.* to what number of places you please.

Example

F Example 1. *Let the two given Numbers be* 2 *and* 4. Place one Foot of your Compasses in 2, and extend the other Foot to 4; then that Foot which now ſtandeth in 2, being turned about, will reach from 4 to 8, and from 8 to 16, from 16 to 32, from 32 to 64, from 64 to 128.

But when your Compaſſes ſtand in 64, if you turn them about yet farther, they will fall beyond the end of the Line; wherefore you muſt place one Foot in ſome other 64, nearer the beginning of the Line, and then the other Foot will reach to 128, and from 128 to 256, and from 256 to 512, and from 512 to 1024; but here it will go off of your Line again, wherefore (as before) you muſt chuſe another 512 nearer the beginning of the Line; and there placing your Compaſſes, they will reach to 1024, from 1024 to 2048, from 2048 to 4096, *&c.*

Example

Example 2. *But if the given Number were* 10 *and* 9 decreasing, then place one Foot in 10 at the end of the *Line*, and extend the other downwards to 9; the same extent will reach still backwards to 8. 1 (or 8 $\frac{1}{10}$) and from 8 1 to 7. 29, and still backwards from 7. 29 to 6. 56.

Likewise, if the two first Numbers had been as 1 to 9, the third Proportional would have been 81, the fourth 729, and the fifth 656, with the same extent of the Compasses.

Again:

Let the two Numbers be 10 *and* 12: place one Foot in 10, and extend the other to 12, that extent will reach from 12 to 14. 41 and from thence to 17. 28.

But if the Numbers were 1 and 12, then the third Proportional would be 144, and the fourth 1720, and all with the same extent of the Compasses.

CHAP.

CHAP. II.

MULTIPLICATION by the Line.

IN Multiplication, the Proportion is this: As 1 upon the Line,
Is to one of the Numbers to be multipled:
So is the other of the Numbers to multipled,
To the Product of them, which is the Number ſought.

Example, 1. *Let it be required to multiply* 5 *by* 7. The Proportion is;

As 1 : to 5 :: ſo is 7 : to 35.

Therefore,

Set one Foot of your Compaſſes in 1, and extend the other Foot to 5; with that extent of the Compaſſes place

place on Foot in 7, and the other Foot will fall upon 35, which is the Product.

Example 2. *Let it be required to multiply* 32 by 9. The Proportion is;

As 1: to 9: ſo 32: to 288.

Set one Foot in 1, and extend the other Foot to 9; that ſame extent will reach from 32 to 288, which is the Product or Sum of 32, being multiplied by 9. Otherwiſe,

Set one Foot in 1, and extend the other to 32; the ſame extent will reach from 9 to 288, as before.

Example 3. *Let it be required to multiply* $8\frac{75}{100}$ *by* $\frac{45}{100}$. The Analogy or Proportion is,

As 1: to 8. 75: ſo 6. 45: to 56. 44: *feré.*

Set one Foot in 1, and extend the other to 8. 75; the ſame extent applied forward upon the Line, will reach from 6. 45, to 56. 44 *feré.*

Or

Or if you ſet one Foot in 1, and extend the other to 6. 45: the ſame extent will reach from 8. 75 to 56. 44 almoſt (namely, to 43 $\frac{3}{4}$) as before.

CHAP. III.

DIVISION by the Line.

IN Diviſion three things are to be minded, *viz.*

The { Dividend, or Number to be divided.
Diviſor, the Number by which the Dividend is divided.
Quotient, which is the Number ſought.

And as often as the Diviſor is contained in the Dividend, ſo often doth the Quotient contain Unity.

For the working of Diviſion, this is the Analogy.

As

As the Divisor,
is to Unity, or 1:
So is the Dividend,
to the Quotient.

Example 1. *Let it be required to divide* 35 *by* 7. The Proportion is;

As 7: to 1:: so 35: to 5.

Set one Foot of the Compasses in 7, and extend the other Foot downwards to 1; that same extent will reach from 35 downwards to 5, which is the Quotient; and so many times is 7 contained in 35.

Otherwise,

Extend the Compasses upwards from 7 to 35; that same extent will reach upwards from 1 to 5, as before.

Example 2. *Let it be required to divide* 288 *by* 32. The Proportion is,

As 32: to 1:: so 288: to 9

Extend

Extend the Compaſſes downwards from 32 to 1, the ſame extent will reach downwards from 288 to 9. which is the Quotient.

Or extend the Compaſſes upwards from 32 to 288; the ſame extent will reach upwards from 1 to 9, as before.

Example 3. *Let it be required to divide* 56.44. *by* 8. 75. The Proportion is;

As 8. 75 : to 1:: ſo 55. 44 : to 6. 45.

Extend the Compaſſes downwards from 8. 75 to 1; the ſame extent will reach downwards from 56. 44 to 6. 45.

Or, Extend them upwards from 8. 75, to 56. 44; the ſame will reach upwards from 1 to 6. 45, as before.

Note this in Diviſion, That ſo many times as the Diviſor may be orderly ſet under the Dividend in Arithmetical Work, ſo many places

ces of Figures shall be in the Quotient of your Division: As if 34784 were to be divided by 75, the Quotient shall consist of three Figures onely, namely of 463, because 75 can be but three times set orderly under 34785, in Arithmetical Operation.

CHAP. IV.

The GOLDEN RULE Direct by the Line.

THis Rule may well be termed the *Golden Rule*, it being the most useful of all others: for having three Numbers given, you may, by it, find a fourth in proportion to them; as by divers Examples following shall be made plain. And this Rule is performed upon the Line, with the like ease and exactness, as any of those

be

before mentioned: And for the working of it upon the line, this is the general Analogy or Proportion.

As the first Number given,
Is to the second Number given:
So is the third Number given,
To the fourth Number required,

Or,

As the first Number given,
Is to the third Number given:
So is the second Number given,
To the fourth Number sought.

∴ Wherefore

Always, *Extend the Compasses from the first Number to the second, and that Distance or Extent applied the same way upon the Line, shall reach from the third, to the fourth Number required.*

Or otherwise, *Extend the Compasses from the first Number to the third, and that extent applied the same way, shall also reach from the second to the fourth.*

Either

Either of these ways will effect the same things, as by Examples following shall be made appear.

And it is necessary thus to vary the Proportion, sometimes, to avoid the opening of the Compasses too wide for when the Compasses are opened to a very large extent, you can neither take off any Distance exactly, nor give so good an estimate of any parts required, as you may do when they are opened to a lesser distance: But this you will find out best by practice; and therefore I will now proceed to Examples.

Example 1. *If* 45 *yards of Cloth cost* 30 *l. what will* 84 *yards cost at the same rate?*

As 45 : to 30 : : so 84 : to 56.

Extend the Compasses downward from 45 to 30, that extent will reach downward from 84 to 56 *l.* the price of 84 yards.

Or

Or, extend the Compasses upward from 45, to 84, the same will reach from 30 to 56, as before.

Example 2. *If 26 Acres of Land* [illegible] *worth 64 l, a year; what is 36 Acres of the like land worth by the year?*

As 26 : to 64 :: so 36 : to 88. 615:

Extend the Compasses from 26 to 64, the same extent will reach from 39 to $18\frac{615}{1000}$ parts (which is about 12 *s.* 3 *d.* 2 *q.*) and so much is 36 Acres of the like Land worth by the year.

Example 3. *If 100 l. yield 6 l. Interest for one year, or 12 Months, what shall 75 l. yield?*

As 100 : to 6: : so 75 : to 4. 50.

Extend the Compasses from 100 to 6, the same extent will reach from 75 to 4 50 (or $4\frac{1}{2}$) which is 4 *l.* 10 *s.* and so much will 75 *l.* yield Interest in the year.

Example 4. *If 75 l. yield 4 l.* 10 *s. Interest for one year, or 12 months, what will 100 l. yield.*

As

As 75 : to 4. 50 :: so 160: to 67.

Extend the Compasses downwards from 75 to 4: 50, the same extent will reach from 100 to 6; and such Interest will 100 *l.* yield.

Many other Questions might be added; but the Rule (and manner of working it) is so plain, that it needs them not; and so general, that he which can resolve one, may as well resolve any other: and therefore I shall say no more of it in this place.

CHAP. V.

The GOLDEN-RULE *Reverse by the Line.*

IN this reverse or backward Rule of Three, this Note is specially to be observed, That if the third Number be greater than the first, then will the

the fourth Number be leſs than the ſecond. And on the contrary, if the third Number be leſs than the firſt then the fourth Number will be greater than the ſecond: As by Example will appear.

Example 1. *If* 12 *Workmen do an Piece of Work in* 8 *days, how many Workmen ſhall do the ſame Piece of Work in* 2 *days?*

It is here to be noted, That in this Queſtion 12 is not the firſt Number (though it be firſt named) but 2; for the middlemoſt Term of the three muſt be of the ſame kind with the fourth Number which is to be ſought; as in this Example it is Men, therefore 12 (which are Men) muſt ſtand in the middle, or ſecond place, becauſe the fourth Number, which is to be ſought, is alſo Men: And therefore the Numbers will ſtand thus;

days,

days.	men.	days.
2	12	8

For if 8 days require 12 men, then 2 days (which is but a fourth part of 8 days) ſhall require four times 12 men, that is, 48 men.

For here, leſs requires more; that is, leſs Time, more Hands: and hence the Work is contrary to the Direct Rule. Wherefore, to effect it,

Extend the Compaſſes from 2 to 8; the ſame extent will reach from 12 (the contrary way on the Line) to 48, which is the number of men that will effect the ſame piece of Work in two days.

Example 2. *If one Cloſe will graze 21 Horſes for 6 Weeks, how many Horſes will the ſame Cloſe graze for 7 Weeks?*

Extend the Compaſſes from 6 to 7; for you muſt always extend your Compaſſes to Numbers of one kind or denomination: as here 6 and 7 are

both Horſes) the ſame extent wi
reach from 21 backward to 18; an
ſo many Horſes will the ſame Clo
graze for 7 Weeks.

CHAP. VI.

Of DUPLICATE PROPORTION by the Line

DUplicate Proportion is ſuch
Proportion as is between Line
and Superficies or between Superfi-
cies and Lines.

I. *Of the Proportion of LINES t
SUPERFICIES.*

In this Caſe, extend the Compaſſe
from the firſt to the ſecond Numbe
of the ſame denomination; that ſame
extent (being doubled) ſhall give th
diſtance from the third Number unto
the fourth.

Example

Example 1. *If the Diameter of a Circle be* 14 *Inches, and the Area or Content thereof be* 154 *Inches; what will be the Content of another Circle, whose Diameter is* 28 *inches?*

Extend the Compasses from 14 to 28; that extent doubled, will reach from 154 to 616: for first it will reach from 154 to 308, and from thence to 616; and that is the Area or Content of a Circle whose Diameter is 28.

Example 2. *If a piece of Land that is* 20 *Pole square, be worth* 30 *l. what is a piece of Land of the same goodness worth, that is* 35 *Pole square?*

Extend the Compasses from 20 to 35; that extent doubled, will reach from 30 to 91. 8, that is, 91 *l.* $\frac{8}{10}$ of a Pound, which is 16 *s.* and so much is such a piece of Land worth.

II. *Of the Proportion of SUPERFICIES to LINES.*

In this caſe, extend the Compaſſe unto the half of the diſtance between the two Numbers of the ſame denomination; that ſame extent ſhall reach from the third Number to the fourth requited.

Example 1: *Let there be two Circles given, the Area or Content of the one being* 154, *and its Diameter* 14: *the Area of the other Circle is* 616; *what is the length of its Diameter?*

Upon your Line divide the diſtance between 154 and 616 into two equal parts; then with that diſtance ſet one Foot in 14, and the other ſhall fall upon 28, which is the length of the Diameter of the other Circle, whoſe Area is 616.

Example 2. *There is a piece of Land containing* 20 *Pole ſquare, worth* 30*l. there is another piece worth* 91*l.* 161*l.* how

How many Pole ſquare ought that piece to contain?

Take with your Compaſſes half the diſtance between 30 *l.* and 91 *l.* 16*s.* then ſet one Foot in 20 Pole, and the other Foot will reach to 35 Pole; and ſo many Pole ſquare muſt the Land be, that is worth 91 *l.* 16*s.*

CHAP. III:

Of TRIPLICATE PROPORTION by the Line.

Triplicat Proportion is ſuch a Proportion as is between *Lines* and *Solids*, or between *Solids* and *Lines*.

I. *Of the Proportion between LINES and SOLIDS.*

In this caſe, Extend the Compaſſes from the firſt Number to the ſecond of the ſame denomination;

that extent (being tripled) ſhall reac
from the third Nubber to the fourt

Example. *There is a Bullet wh*
Diameter is 4 *Inches, weighing* 9
what ſhall another Bullet of the ſa
Metal weigh, whoſe Diameter ſhall
8 *inches.*

Extend the Compaſſes from 4
8 (the two Diameters) the ſame ex
tent (being tripled) will reach from
to 72, which is the weight of a Bulle
whoſe Diameter is 8 inches.

II. *Of the Proportion of* SOLIDS *to* LINES.

In this caſe, Extend the Compaſſe
into the third part of the Diſtance be
tween the two Numbers of like deno
mination; that ſame extent ſhall reach
from the third to the fourth Number
required.

Example. *The weight of a Cube*
being 72 *pound, the Side whereof wa*
8 *Inches;*

8 Inches; and the weight of another Cube of the same matter weighing nine pound, what must the Side be?

Upon your Line divide the distance between 9 and 72 into three equal parts; then set one Foot of that distance in 8, and the other Foot shall rest in 4, the length of the side of the Cube required.

CHAP. VIII.

The Extraction of the SQUARE-ROOT *by the Line.*

TO Extract the *Square-Root*, is to find a mean Proportional Number between 1 and the Number given; and therefore is to be found by dividing the space between them into two equal parts.

Example. *Let it be required to find the Square-root of* 36.

Extend the Compasses from 1 to 36, the middle way upon the Line between these two Numbers is 6, which is the Square-Root of 36. In like manner you may find the Square-Root of 81 to be 9, of 144 to be 12, of 256 to be 16; and of other Numbers, as in this Table.

Root.	*Square.*	*Root.*	*Square.*
1	1	11	121
2	4	12	144
3	9	13	169
4	16	14	196
5	25	15	225
6	36	16	256
7	49	17	289
8	64	18	324
9	81	19	361
10	100	20	400

If

If you ſuppoſe the Number to have Pricks over every ſecond Figure, as is uſual in the Arithmetical Operation, then if the laſt Prick towards the left hand fall over the laſt Figure (which will always be when the number of Figures are odd) then it will be beſt to place Unity at the 1 in the middle of the Line, ſo that the Root and the Square may both fall forwards towards 10 at the end of the line.

But if the Number of Figures be even, it will then be beſt to place Unity at 10 at the end of the Line; ſo the Root and the Square both will fall backwards towards the middle of the line.

CHAP. IX.

The Extraction of the CUBE-ROOT by the Line.

TO Extract the *Cube-Root*, is to find the firſt of two mean Proportionals between 1 and the Number whoſe *Cube-Root* you require; and is therefore to be found upon the line, by dividing the ſpace between them into three equal parts.

Example. *Let it be required to find the Cube-Root of* 216.

Extend the Compaſſes from 1 to 216, one third part of that diſtance ſhall reach from 1 to 6, which is the *Cube Root* of 216. In like manner may you find the *Cube-Root* of 729 to be 9, of 1728 to be 12, of 110592 to be 48, of 493039 to be 79, *&c.* as in this Table.

Root.

Root.	Cube.	Root	Cube.
1	1	11	1331
2	8	12	1721
3	27	13	2197
4	64	14	2744
5	125	15	3375
6	216	16	4096
7	343	17	4913
8	512	18	5832
9	729	19	6859
10	1000	20	8000

Now because it is troublesom in the *Square-root* to divide the space into two, and in the *Cube-Root* into three equal parts, you may (if you have often occasion for this Work) have on your Rule other Lines of Numbers, as one twice, and another thrice so long as the other; and then this Work may be wrought upon the Lines, without dividing the distance upon the Line.

CHAP.

CHAP. X.

The Use of the LINE applied to SUPERFICIAL-MEASURE, such as Board, Glass, Wainscot, Pavement, Hangings, Painting, &c. of what kind soever.

THE Measures by which Board, Glass, Timber, Stone, and such like, are Measured, is by the Foot; a Foot containing 12 Inches; and each Inch into eight Parts, called Halves, Quarters, and Half-quarters: but this kind of division not being consentaneous or agreeable to the divisions upon your Line of Proportion, where between 1 and 2 is divided (not into 8, but) into 10 parts, the like between 2 and 3 into 10 parts, and so between 3 and 4, 4 and 5, *&c.* Therefore I hold it

it requiſite, both for eaſe and exactneſs, to have every Inch on your Two foot Rule divided not into 8, but into 10 equal parts, which hereafter (throughout this Book) we will call Inch-meaſure.

Again, Whereas your Foot is divided into 12 equal parts, called Inches, I would have your Foot divided into 10 equal parts, and each of thoſe parts ſub-divided into 10 other equal parts; ſo will your whole Foot contain 100 equal parts, which will be agreeable to the diviſions of your Line, and facilitate the Work, as by the Examples in this kind given will be made to apear; and this we ſhall hereafter call Foot meaſure

But if any Perſon be ſo wedded to Inches, Halves, and Quarters, that he will not be beaten out of his Opinion, but perſiſt therein, and yet is deſirous to have knowledge in the Uſe of this Line; I ſay, ſuch Perſon may have added

ded to the ſide of his Inches, Halves and Quarters, (by way of Facing, as I term it) a Line of Foot-meaſure, and alſo his inches into 10 as well as 8, ſo that he may meaſure by one, and work upon his Line by the other. And this indeed will be neceſſary to be done upon the Rules of thoſe ingenious Artificers who need them not; for that they many times meet with wilful Perſons, that will have them to meaſure their way, how diſconſentaneous to Reaſon ſoever it be.

In this nature would I have the Rule divided; and in this manner have I cauſed them to be made, both for my ſelf, and others: And a Figure of Foot and Inch-meaſure I have inſerted towards the beginning of the Book.

And here note, that what is here ſaid concerning dividing the Inch and Foot into 10 parts, the like is to be underſtood of the

the Yard, Ell, Pole, or Perth, or any other Meaſure whatſoever.

Theſe things being premiſed, we will now proceed to Examples,

I. *Examples in Inch meaſure only.*

Example 1. *Let a Board or Plank be 27 Inches broad, and 263 Inches long; how many ſquare Inches is there in ſuch a Plank?* The Proportion is,

As 1, is to 27 the breadth in Inches:
So is 263, the length in Inches, to 7101, the Number of ſquare inches in the whole Plank.

Extend the Compaſſes from 1 to 27; the ſame extent forwards will reach from 263. to 7101, the Content.

Or, you may extend the Compaſſes from

from 1 to 263, the ſame will reach from 27 to 7101, as before.

Example 2. *Let a Pane of Glaſs be* 53. 4 *Inches broad, and* 126. 8 *Inches long; how many Foot is there in that Pane?* The Proportion is,

As 144 (becauſe 144 inches make 1 Foot)
is to 53 4, the breadth in inches:
So is 126.8, the length in inches,
to 47. 06, the Content in Feet.

Extend the Compaſſes from 144 to 53. 4; the ſame will reach from 126. 8 to 47. 06, which is 47 Foot and $\frac{006}{100}$ parts of a Foot, the Content of the whole Pane.

Example 3. *If a Marble Foot pace or Walk be* 20 *Inches broad, how much in length of that will make a Foot ſquare?* The Proportion is,

As

As 20, the breadth in inches,
is to 144, the inches in one Foot:
So is 1 Foot, unto the length of
one Foot in inch-measure.

Extend that Compasses from 20 to 144; that extent will reach from 1 to 7. 2: so that 7 inches and $\frac{2}{10}$ of that breadth will make a Foot square.

II. *Example in Foot-measure onely.*

Example 1. *Let a Floor or Stone-pavement be* 52 *Foot broad, and* 110. 5 *Foot long, how many Foot square is that Floor or Pavement?* The Proportion is,

As 1 Foot,
to 52 Foot the breadth:
So 100. 5 Foot the length,
to 5746 the Content in square
Feet.

Extend the Compasses from 1 to

52, the ſame will reach from 110. 5 to 5746, the content of the Pavement or Floor in ſquare Feet.

Example 2. *There is a Plank of Cedar 2 Foot 25 parts broad; how much in length thereof will make a Foot ſquare?* The Proportion is,

As 2. 25 the breadth,
is to 1:
So is 1, or any number of Feet,
to the length of a Foot ſquare in
Foot meaſure.

Extend the Compaſſes from 2. 25 to 1; that extent will reach back from 100, which one Foot, to 44 parts; and ſo many parts in length of that Plank will make a Foot. In like manner 88 parts will make 2 Foot, 1 Foot 32 parts will make 3 Foot, &c. For,

As 2. 25 is to 1 Foot:

So

	parts.		parts.
So is	100	to	44
	200		88
	300		132, &c.

III. *Examples in Inch measure and Foot measure together.*

Example 1. *Let a Board be* 30 *Inches broad, and* 15 *Foot and* $\frac{1}{2}$ *or* 25 *parts long; how many Foot square doth such a board or Plank contain?* The Analogy is,

As 12 Inches,
to 30 the breadth in Inches:
So 15. 25 the length in Feet,
to 38. 125 the content in Feet.

Extend the Compasses from 12 to 30, the same will reach from 15 25 to 38. 125; and so many Foot square is contained in such a Plank.

I will conclude this chapter with this

this useful and necessary *Problem*: namely;

By having the length and breadth of any long Square, or Parallelogram, to find the length of the Side of a Geometrical Square equal thereunto.

This by the Line is easily effected; for if you take the half-distance upon your Line between the length and the breadth, the Number upon which the Compass point resteth, shall be the length of the Side of the Geometrical Square equal to the Long Square or Parallelogram.

Note, By a long Square or Parallelogram is meant any Square whose Sides are longer one than another, as any long Table, &c. But a Geometrical Square is that whose 4 sides are all of one length.

Example. Let the longer Side of a Parallelogram be 183 inches, and the breadth 30 inches: If you divide the distance upon your line between these

these two Numbers into two equal parts, the Compass-point shall rest upon 74 Inches 10 parts: So that a Geometrical Square whose Side is 74. 10; shall be equal in Area to a Long Square whose Sides are 30 and 183.

CHAP. V.

Of YARD MEASURE by the Line.

MANY Artificers, as Joyners, Painters, Plaisterers, Paviers, Upholsters, measure and sell their Work, not by the Foot, but by the Yard: it will be necessary to give Examples in this kind of Measure also. And here also it is requisite that, your Yard be divided into 100 parts and

and not into Halves, Quarters, and Nails: which ſuppoſed, take theſe Examples following.

Example 1. *A Joyner hath Wainſcoted a Gallery containing* 130 *Yards* 25 *parts about, and in height* 15 *Yards* 50 *parts; how many ſquare Yards is in that Gallery?* The Proportion is,

As 1 yard,
to 1550 yards the height:
So 130. 25, the Compaſs in yards,
to 20 18. 87, the Content in yards.

Extend the Compaſſes from 1 to 15. 50 the breadth, the ſame extent will reach from 130. 25 the length, to 20 18. 87: and ſo many ſquare Yards of Wainſcoting is in that Gallery.

Example 2: *A Painter hath painted Lands, kip, or other Work, over the Wainſcot of a Room, which is* 1. *Yard* 75 *parts of a Yard deep; how much*

in

in length thereof will make a Yard Square?

As the breadth 1. 75,
Is to 1 yard, or 100 parts:
So is 1, or any other number of yards,
To the length of a yard ſquare

Extend the Compaſſes from 1 to 1. 75; the ſame extent will reach from 100 (or one yard) to 75. 14: and ſo much in length of that Painting will make a yard ſquare.

Example 3. *A Plaiſterer hath laid and beautified a Cieling, containing* 13 *yards broad, and* 63 *yards* 30 *parts long; how many ſquare yards is there in that Cieling?*

As 1 yard,
To the breadth 13 yards:
So the length 63. 30,
To the Content.

Extend the Compaſſes from 1 to 13,

13; the ſame extent will reach from 63. 30, to 823 almoſt; and ſo many ſquare Yards are there in ſuch a Cieling.

Note, It may ſo fall out ſometimes, that it will be required to meaſure ſome piece of Work, and to give an eſtimate of the quantity of the Yards therein contained, when you have not a Yard thus divided by you, but onely your Two foot Rule, for the ſupplying whereof, I will add this following Problem.

PROBLEM.

The length and breadth of any Superficies being given in Feet, to find the Content thereof in Yards.

Let the breadth of a piece of any Work, to be paid by the yard, be 4 Foot, and the length thereof 12 Foot, how

how many ſquare Yards are contained therein?

The Analogy or Proportion is,

As 9,
is to 4, the breadth in Feet:
So is 12, the length,
to $5\frac{35}{100}$, the content in Yards.

Extend the Compaſſes from 9 to 4, the ſame extent will reach (the ſame way) from 12 to 5. 35, that is, to 5 Yards and 35 hundred parts of a Yard, which is 35 Yards, one Quarter, and almoſt Half a quarter of a Yard.

And what is here ſaid of Meaſuring by the Foot, and giving of the Content in yards, the ſame may be effected if the Dimenſions be taken in Feet, and the Reſult required in Ells, or other Meaſure.

CHAP. XII.

Of LAND-MEASURE by the Line.

THE uſual Meaſures for Land are Chains, of which there are divers ſorts; but the Denominations that the quantity of Land is given in by, are Acres and Perches.

The Chains now moſt in uſe are principally two.

One containing 1 Perch in length, } each of them divided into 100 Links:
The other 4 Perches in length, }

For the Practice of them, take theſe Examples.

I. By

I. *By the* 1 *Pole-Chain.*

Example 1. *There is a Plat of Ground* 30 *Perches broad, and* 183 *Perches long; how many Perches doth it contain?*

As 1,
to 30 the breadth:
So 183 the length,
to 5490 the Content.

Extend the Compaſſes from 1 to 30; that ſhall reach from 183 to 5490 the Content.

Example 2. *But the length and breadth of the ſame piece of Ground being given as before in Perches; if it were required to find the Content in Acres,* then,
As 160,
to 30 the breadth:

So 183,
to 34 Acres $\frac{31}{100}$ parts of an Acre.

Extend the Compasses from 160 to 30, the same will reach (being extended the same way) from 183 to 34.31, that is, 34 Acres 31 hundred parts of an Acre, which is something above a Rood.

II. *By the Four Pole Chain.*

Example 1. *A piece of Land containing* 16 *Chains* 25 *Links in breadth, and* 57 *Chains* 30 *Links in length, how many Acres doth it contain?* The Analogy is,

As 10,
to 16.25, the breadth in Chains and Links:
So is 57.30, the length in Chains
to 93 Acres $\frac{225}{10000}$ parts of an Acre.

Extend

Extend the Compaſſes from 10 to 16. 25; the ſame extent will reach from 57. 3, to 63. 0925.

Example 2. *The Baſe and Perpendicular of a Triangle being given in Chains and Links, to find the Content in Acres.*

This is a right uſeful and neceſſary Propoſition; for by it all manner of Irregular Plats of Land are caſt up: But my Intent here is not to teach Surveying, but to ſhew the uſe of the Line of Proportion.

Wherefore, Let the Perpendicular of the Triangle be 7 chains 50 links, and the Baſe 45 chains 75 links; the Proportion will be,

As 20,
to 7. 50, the Perpendicular:
So is 45 75, the Baſe,
to 17. 15, the content.
Extend the Compaſſes from 20 to,

7. 50, that extent shall reach from 45. 10, 17. 15, which is 17 Acres, and $\frac{151}{100}$ parts.

Example 3. *Having the length of any Furlong given, to find what breadth it must have to make an Acre.*

Let the length of the Furlong be 12 chains 50 Links; then to find the breadth for one Acre, this is the Analogy:

As 15. 20, the length in Chains,
is unto 10:
So is 1 Acre,
to 80 links, which must be the breadth of the Furlong.

Wherefore.

Extend the Compasses from 10 to 12. 50, the same will reach from 1 Acre to 80 links, the breadth of the Furlong.

CHAP.

CHAP. XIII.

Of the Menſuration of divers Regular SUPERFICIAL FIGURES *by the Line.*

HAving ſufficiently ſhewn the manner of meaſuring of ſuch Superficial Figures as are meaſured by length and breadth, I will now ſhew you how by the Line to meaſure ſome other Regular Figures, as the Circle, *&c.*

I. *Of the Circle.*

Example 1. *The length of the Diameter of any Circle being given, to find the Circumference thereof.*

The Proportion between the Dia-

meter and the Circumference of any Circle is as 7 to 22; or, in exacter terms, as 1000 to 3140.

Wherefore,

If the Diameter of a Circl given, be 23 inches, the Circumference thereof may be found by this following Analogy:

As 1. 000,
is to 3. 140:
So is 12 the Diameter.
to 37. 68, the Circumference.

Wherefore extend the Compasses from 1. 000 to 3. 140, the same extent will reach from 12, to 37 Inches 68 parts, which is the Circumference.

Example 2. *The Circumference of any Circle be given to find the length of the Diameter.*

This is the converse of the former Example, and the Analogy is the converse also.

Let

Let the Circumference of a Circle be 37 Inches 68 parts what is the length of the Diameter?

As 3. 140,
to 1. 000:
So is 37 Inches 68 parts, the Circumference,
to 12 inches the Diameter.

Extend the Compasses from 3.140 to 1. 000; the same extent will reach from 37. 68 to 12, the Diameter required.

Example 3. *Having the Diameter of a Circle, to find the length of the Side of a Square which shall be equal in content to the same Circle.*

If the Diameter of a Circle be 12 inches, the Proportion is,

As 1. 000,
is to 12 inches, the Diameter:
So is 8862,
to 10. 63, the Side of the Square:

Extend the Compaſſes from 10000 to 12; the ſame extend will reach from 8862, to 10 Inches 63 hundred parts, the ſide of a Square equal in Area to the Circle whoſe Diameter is 12 Inches.

Example 4. *Having the Circumference of a Circle given, to find the Side of a Square equal to that Circle.*

Let the Circumference of the given Circle be 37 Inches 68 parts: The Proportion is,

As 10000,
to 37. 68, the Circumference:
So is 2821.
to 10.63, the ſide of the Square.

Extend the Compaſſes from 10000 to 37. 68, the ſame will reach from 2821 to 10 inches 63 parts, the ſide of the Square required.

Example 5. *The Diameter of a Circle*

Circle being given, to find the Superficial Content thereof.

Let the Diameter of a Circle be 15 Inches.

Extend the Compasses from 1 to 15 the Diameter; then apply one Foot of that distance (always) to 78. 54: then turn that distance twice from this Number the same way and the Compass-point will fall upon 176 inches 74 parts, which is the Area of that Circle whose Diameter is 15 inches.

Example 6. *The Circumference of a Circle being given, to find the Area thereof.*

Let the circumference of a Circle given be 47 inches 13 parts.

Extend the Compasses from 1 to 47. 13 the Circumference; this distance being applied (always) to this Number 7958, and from thence twice repeated, the Point of the Compasses at the second remove will fall upon 176

176 inches 74 parts, equal to the Area of the Circle, as before.

Here note, That your Compaſſes being opened from 1 to 37. 13 the Circumference, when you come to ſet one Foot upon 7958, the other will reach at your firſt turning over to 37. 8; and when you turn them over again, it will fall out of the Line: wherefore you muſt ſet one Foot in 37. 8, in the lower part of the line, and then the other will fall upon 176. 74. And this you muſt do in othercaſes, when ever your Compaſs-point goes beyond your Line.

CHAP.

CHAP. X.

II: *Of the* TRIANGLE.

A Triangle is a Figure consisting of three Sides and three Angles, the longest Side whereof we call the Base; and a Line drawn from the Angle opposite to the Base, we call the Perpendicular.

To measure Triangles there are several ways; I will only shew you one or two to be done by the line.

Example 1: *There is a Triangle whose Base is* 14 *Foot, and his Perpendicular* 6 *Foot; I would know how many square Foot is contained in this Triangle.* The Proportion is,

As

As 2,
is to 6, the Perpendicular:
So is 14, the Baſe,
to 42, the Area.

Or,

As 1,
is to 3, half the Baſe:
So is 14, to 42 the Area.

Or,

As 2,
is to 6, the Perpendicular:
So is 7, half the Baſe,
to 42, the Area:

Or,

As 1,
is to 6, the Perpendicular:
So is 14, the Baſe,
to 84, the double Area.

All theſe ways produce the ſame effect; but the firſt is the beſt:

Where.

Wherefore,

The Baſe of your Triangle being 14, and the Perpendicular 6; Extend the Compaſſes from 2 to ſix, the ſame extent will reach from 14 to 42, the Area.

III. *Of the Trapezia.*

A Trapezia is any Right lined Figure conſiſting of four unequal ſides, and as many Angles: For the meaſuring of it, you muſt firſt reduce it into two Triangles, by drawing a Line or Diagonal from one oppoſite Angle to another, the longeſt way; then from the two Angles oppoſite to this Line, let fall two Perpendicnlars; ſo is the *Trapezia* divided into two Triangles. The manner how to meaſure it is this.

Example. *There is a Trapezia whoſe Diagonal is* 12:34, *and one Perpendicular*

pendicular is 4. 20, *the other* 5. 07; *I would know the Content or Area thereof*

The two Perpendiculars added together make 9. 27. Then the Analogy is,

As 2,
is to 9. 27, the ſum of the Perpendiculars:
So is 12. 34, the Baſe,
to 57. 17, the Area.

There are as many ways to meaſure Trapezias, as in the laſt Example I gave you for Triangles; but this is the beſt.

And here note, That if you are to meaſure any irregular Piece, of what nature ſoever, whether Land, Board, Glaſs, Pavement, or the like, your beſt and exacteſt way is to reduce them to Trapezias, and meaſure them as before is taught:

IV. *Of*

IV. *Of Regular Figures of* 5, 6, 8, 10, *or* 20 *equal sides.*

These Figures by Geometrecians are called *Regular Polygons*; and the way to measure them, is by adding all the Sides together: Then measure the length from the Center of the Figure, to the middle of one of the Sides; by the help of these two you may find the Area of the Figure.

Example. *Let there be a Regular Polygon of* 11 *equal sides, each side being* 7 *Inches, and let the length of the Line from the Centre to the middle of one of those sides be* 12 *Inches.*

Add all the Sides together, they make 77; then,

As 2,
is to 77, the sum of the Sides:
So is 12, the length of the Line from the middle of the Figure,
to 462, the content of the Figure.

CHAP.

CHAP. XV.

The Use of the LINE applied to SOLID MEASURE; such as Timber, Stone, &c.

TImber and Stone are usually measured by the same Rule or Measure as Board and Glass are, namely, by Feet and Inches: Therefore such a Rule as was mentioned in the beginning of the Tenth Chapter, is fit for this Business also.

Before we come to shew the way of Measuring of Stone or Timber, it will be necessary to premise thus much; That the Base or end of every piece of Timber or Stone is (or must be supposed) either exactly square, that is, every

ry ſide alike, or elſe one of the ſides longer than the other: wherefore the firſt thing to be done is to find the Area or Superficial content of the Baſe or end of any pieceof Timber or Stone to be meaſured; which may be done ſeveral ways, either in Inch-meaſure, as by the firſt Example of the firſt part of the tenth Chapter; or in Foot-meaſure, by the firſt Example in the ſecond part of the ſame Chapter; or both in Foot-meaſure and Inch-meaſure, as in the firſt Exampe of the third part of the ſame tenth-Chapter; and therefore need not be here repeated again: Wherefore, we will proceed to our intended purpoſe of Meaſuring, firſt, by Inch-meaſure only; ſecondly, by Foot-meaſure onely; and thirdly, by both together: as we didbefore in the Meaſuring of Board, *&c.*

I. *In*

I. *In Inch measure onely*

Example 1. *There is a piece of Timber* 30 *Inches broad*, 21 *Inches* 6 *parts deep, and* 183 *Inches long; how many square Inches is there in this solid piece of Timber?* The Proportion is,

1. As 1,
unto 30 inches the breadth:
So is 21 6 inches the depth,
to 648 inches, the content of the base of the piece.

2. As 1,
unto 648, the content of the base:
So is 183 inches, the length of the piece,
to 118584, the solid content in inches.

Wherefore, Extend the Compasses from 1, to 30 the breadth; the same

ſame will reach from 21. 6, the depth, to 648, the content of the baſe.—— Again, Extend the Compaſſes from 1, to 648, the content of the Baſe; that extent will reach from 183 the length, to 118584 Inches the ſolid content. But ſo many places of Figures cannot well be eſtimated upon your Line, except it be very large; but by the following Examples you ſhall have your deſire accompliſhed exactly and eaſily.

Example 2. *To find the Content of the ſame piece of Timber in Foot-meaſure, the Dimenſions being given in Inchs and Parts?* The Peoportion is,

1: As 1,
to 30 the breadth:
So is 21. 6 the depth,
to 648, the content of the Baſe,
as before.

2: As 17 28, the number of ſolid Inches in a Foot of Timber, is to 648, the Content of the Baſe:
So is 183 the length in Inches, to 68 Foot and $\frac{62}{100}$ parts of a Foot, as before.

Wherefore, as before, extend the Compaſſes from 1, to 30 the breadth, the ſame will reach from 21. 6 the depth, to 648 the content of the Baſe, as before. —— Again, Extend the Compaſſes from 1728, to 648 the Baſe; the ſame extent will reach the ſame way from 183 the length, to 68. 62 the Content of the piece of Timber in Feet and parts, that is 68 Foot, and above half a Foot.

Example 3: *Let a ſquare Stone or piece of Timber be* 30 *Inches broad, and* 21 *Inches* 6 *parts deep; how much in length ſhall make a Foot ſquare of that piece of Timber or Stone?*

You

You may find the content of the Baſe, as in the laſt Example, to be 648 inches: then the Proportion is,

As 648, the Content of the Baſe:
is to 1728, the inches in a Foot,
So is 1,

to 2 Inches 67 parts, the length of a Foot ſolid.

Therefore extend the Compaſſes from 648 the Baſe, to 1728; the ſame will reach from 1, to 2.67: So that 2 inches $\frac{67}{100}$ parts will make a Foot ſolid of that piece of Timber or Stone.

This may be done another way, by this Anology or Proportion.

1: As 12,
to 30, the breadth in Inches,
So 21. 6, the depth in inches,
to a fourth Number (which h
will be about 54.)

2. A

2. As to this fourth Number 54,
is to 144:
So is 1,
to 2. 67, the length of a Foot
ſolid.

Wherefore, Extend the Compaſſes from 12, to 30 the breadth, that extent will reach from 21. 6 the depth, to a certain place upon the Line (about 54) where keep the Point of the Compaſs faſt, and open the other to 144, then will this extent of the Compaſſes reach from 1, to 2 inches 67 parts, the length of a Foot ſolid, as before.

II. *In Foot meaſure onely.*

Example 1. *Let a Stone or a piece of Timber be* 2 *Foot* 50 *parts broad, a Foot* 80 *parts deep, and* 25 *Foot* 15 *parts long, how many ſolid or cubical Feet doth ſuch a piece contain?*

The

The Proportion is,

1. As 1,
   is to 2. 50 Foot the breadth:
   So is 1. 80 Foot the depth,
   to 4. 50 Foot, the Base in Foot-measure.

2. As 1,
   unto 4. 50, the Base:
   So 15 25, the length,
   to 68. 62, the Content in Feet.

Extend the Compasses from 1 to 2.50 the breadth; the same will reach from 1. 80 the depth, to 4. 50 the Base.—Again, Extend the Compasses from 1 to 4. 50 the Base; that extent will reach from 15. 25 the length, to 68. 62, the Content in Feet.

Example 2. *In the forementioned Piece of squared Stone or Timber, being 2 Foot 50 parts broad, and 1 Foot*

80 *parts deep, Let it required beto fi*
how much thereof in length will make
Foot. The Proportion is,

1. As 1,
   is to 2. 50, the breadth:
   So is 1. 80, the depth,
   to 4. 50, the content of the Ba
   in Foot measure.
2. As 4. 50, the Base,
   is to 1.
   So is 1 Foot,
   to 222 parts, the length of
   Foot solid.

Wherefore, Extend the Compa
ſes from 1 to 2. 50 the breadth; t
ſame extent will reach from 1. 80 t
depth, to 4. 50 the Content of t
Base.——Again, Extend the Com
paſſes from 4. 50 the Baſe, to 1; t
ſame will reach from 10, to 222 part
the length of a Cubical or Solid Foo
of that Stone or Piece of Timber.

III. I

III. *In* FOOT-MEASURE *and* INCH-MEASURE *together.*

Example. *Let a squared Stone or Piece of Timber be* 30 *Inches broad,* 27.6 *Inches deep, and* 15 *Foot* 25 *parts long; How many Cubical or Solid Foot of Stone or Timber is there in that Piece?* The Proportion is,

1. As 1,
   is to 30 Inches, the breadth:
   So is 21. 6 Inches, the depth,
   to 640, the Content of the Base in Inches.

2. As 144, the Inches in a Foot Superficial,
   is to 648, the Content of the Base in Inches:
   So is 15. 25, the length of the Piece in Foot-measure,
   to 68 Foot 62 parts.

Wherefore, Extend the Compasse from 1 to 30 the breadth; the same will reach from 21. 6 the depth, to 648, the Content of the Base.—Again, Extend the Compasses from 144, to 648 the Content of the Base, the same extent will reach from 15. 25 the length of the Piece, to 68. 62, the solid Content of the Stone or Timber in Feet and 100 parts of a Foot.

By having the same things given in the same piece of Stone or Timber (or in any other) the Work may be varied several ways: The Analogies or Proportions I will onely give you, leaving the Practice thereof to your self.

Breadth of the Piece, 30 Inches,
Depth of the Piece, 21. 6 Inches.
Length of the Piece, 15. 25 Foot.

The

The Proportion is,

As 144,
to 30, the breadth:
So 21. 6, the depth,
to a fourth Number.

From which fourth Number, if you extend your Compasses to 1, and place one Foot in 15. 25, the length of the Piece, the other Foot shall fall upon 68. 62, the Content of the Stone.

Or,

As 12,
unto 30, the breadth;
So 21. 6, the depth,
to some fourth Number.

From this fourth Number extend the Compasses to 12, that distance will reach from 15. 25, the length of the Piece, to 68. 62, the Content of that Piece.

CHAP. XVI.

How to measure Stone or Timber by the Line, by having the Square of the Base, and the length of the Piece given, both in Foot and Inch measure.

HOW to find the length of a Side of a Geometrical Square, that shall be equal to any Parallelogram or Long Square, is taught at the latter end of the Tenth Chapter of this Book, by which Rule it may at any time be found. That being done there, I shall onely here begin with Examples.

Example

Example 1. *There is a Squared Piece of Timber whose length is* 183 *Inches, and the Side of the Square equal to the Base or end thereof is* 25 *Inches* 45 *parts; how many foot doth that Piece contain?*

1. As 41. 57,
   to 25.45, the Side of the Square:
   So is 183, the length in Inches,
   to a fourth Number,

2. And that fourth Number,
   to 68.62, the content in Feet.

Extend the Compasses from 41. 57, to 25. 45. the side of the Square; the same will reach from 183 the length, to some other part of the Line, from whence if you again extend the same distance, the Point will rest upon 68 Foot 62 parts of a Foot; and so many Foot is in the Piece.

Example 2. *Let the ſide of a Square equal to the Baſe of a Piece of Stone or Timber, be* 2 *Foot* 12 *parts, and the length of the ſame Piece* 15 *foot* 25 *parts; How many ſolid feet is there in that Piece?*

1. As 1,
to 2 Foot 12 parts, the ſide of the Square:
So 15 Foot 25 parts the length,
to a fourth Number;

2. And that fourth Number,
to 68. 62, the Content in Feet.

Extend the Compaſſes from 1 to 2. 12, the ſide of the Square; that will reach from 15. 25, the length, to ſome other Number on the Line; from whence the Compaſſes being extended, the movable Point will fall upon 68. 62, the Content, as before.

Example

Example 3. *The Side of a Square, equal to the Base of a Stone, being 25 Inches 45 parts, and the length of that Stone 15 Foot 25 parts, how many Foot doth it contain?*

1. As 12,
to 25.45, the Square in Inches:
So is 15. 25 Foot the length,
to a fourth Number;

2. And that fourth Number,
to 68. 62, the Content.

Extend the Compasses from 12 to 25. 45 the side of the Square; the same will reach from 15. 25 to some other point upon the Line, from whence the Compasses being extended, the movable Point will fall upon 68 Foot 62 parts, the Content of the Stone.

Example 4. *There is a piece of Timber whose Side of the Square of the Base is 25 Inches 45 parts, How much in length of that Piece will make a Foot solid?*

1. As 25.45, the side of the Square,
   is to 41.57.
   So is 1 Foot,
   to a fourth Number;
2. And that fourth Number,
   to 6 inches 67 parts.

Wherefore, Extend the Compasses from 25. 45 the side, to 41. 57; the same will reach from 1, to some other point, from whence the Compasses being extended, will reach to 6. 67, the length of a Foot solid of that Piece of Timber.

Example 5. *The length of the Side of a Square, equal to the Base of a Piece*

of

of Timber being 2 Foot 12 parts, to find how much in length of that Piece will make a Foot ſolid in Foot-meaſure.

As 2. 120, the ſide of the Square
is to 1. 000:
So is 1. 000,
to a fourth Number;
And that fourth Number,
to 0. 471 parts of a Foot, to
make a Foot ſquare,

Extend the Compaſſes from 2. 120 the ſide of the Square, to 1000; the ſame extent will reach from 1000 downwards, to ſome other Point upon the Line, and from thence downwards, to 222 part of a Foot; and ſo much in length will make a foot ſolid.

CHAP.

CHAP. XVII.

Concerning Timber that is bigger at one end than at the other, either Round or Square; and how to measure it.

I. *For* SQUARED-TIMBER.

IN large Timber-trees, when they are squared, there is a great disproportion between the Squares of both ends; wherefore some do use to take the Square of the middle of the Piece for the mean or true Square, but this is not exact, though much used; but the best way is this: Find by the Problem at the end of the tenth Chapter of this Book, the length of the side of a Square equal to

to both the ends of the Piece, add these two sides together, and take the half thereof for the true Square; and with that Square you may by the Rules of the last Chapter measure it as if it were perfectly square.

II. *For* ROUND-TIMBER.

The ordinary way used for the measuring of Round-Timber, is to girt it about the middle with a Line, and to take one fourth part thereof for the Side of a Square equal thereto: but this is false, though most Men use it, Custom having made it bear the face of Truth; for it is more in Measure than in reality it should be.

But the exact way of measuring of Round-Timber (especially if it be growing) is this: About the middle thereof

thereof, in ſome ſmooth place, girt the ſame about with a String: Then have you this Proportion;

As 1000,
is to the number of Inches about
So is 2821,
to the length of the ſide of a Square equal thereunto.

So if a Tree, being girt about, as above ſaid, ſhall contain in circumference 47 Inches 13 parts:

If you extend the Compaſſes from 1000 to 47 Inches 13 parts, the ſame extent will reach from 2821, to 13 Inches 29 parts, which is equal to the ſide of a Square equal to that Tree, which being obtained; the Tree may be meaſured divers ways, according to the Examples in the laſt Chapter.

CHAP.

CHAP. V.

Concerning the measuring of Regular Solids, or Cylinders, Globes, Cones, and such like.

I. *Of the* CYLINDER.

A *Cylinder* is a round Figure, of equal Circumference in all parts thereof, as a standing Pillar, a Rouling-stone for Garden-walks, &c. To measure such a Figure there are several ways, both by having the Circumference given when it is standing or by having the Diameter at the end thereof when it is lying, or by having the side of a Square equal to the Base thereof.

I. *By having the Diameter given.*

Example 1. *The Diameter being 15 Inches, how much in length makes a Foot?*

As 15, the Diameter,
to 46. 90:
So is 1,
to a fourth;
And that fourth,
to 9. 78, the length of a Foot.

Extend the Compasses from 15 the Diameter, to 46. 90; that extent will reach from 1, to another Point upon the Line, and from thence to 9 inches 78 parts, the length of a Foot solid.

Example 2. *The Diameter being 1 Foot 25 parts, how much in length makes a Foot in Foot-measure?*

As

As 1.25, the Diameter in Feet,
unto 1. 128:
So 1,
to a fourth Number;
And that,
to 8. 14, the length of a Foot ſolid in Foot-meaſure.

Extend the Compaſſes from 1.25 the Diameter, to 1. 128; the ſame will reach from 1 to ſome other Number, and from thence to 1 Foot 128 parts of a Foot, the length of a Foot ſolid.

Example 3. *Having the Diameter* 15 *Inches, and the length* 105 *Inches; How many ſolid Inches doth the Cylinder contain?*

As 1. 128,
to 15 Inches, the Diameter:
So is 105 Inches, the length,
to a fourth Number;
And that,
to 18555.34 Inches, the content.

Extend

Extend the Compaſſes from 1.128 to the 15 the length; the ſame extent will reach from 105 the length, to ſome other Number, and from thence to 18555, 34 inches, the Content of the Cylinder in inches.

Example 4. *Having the Diameter* 1 *Foot* 25 *parts, and the length* 8 *foot* 75 *parts, to find the Content in feet.*

As 1. 128,
to 1. 25 the Diameter:
So is 8 75, the length,
to a fourth;
And that fourth,
to 10 74 Foot, the content.

Extend the Compaſſes from 1 128, to 1. 25 the Diameter; the extent will reach from 8. 75 the length, to ſome other Number, and from that to 10 Foot 74 parts, the content.

Example 5. *Having the Diameter*

15 *Inches, and the length* 105 *Inches, how many Foot doth it contain?*

As 46. 90,
to 15 Inches, the Diameter:
So is 105 Inches the length,
to a fourth;
And that fourth,
to 10 Foot 74 parts, the Content.

Extend the Compasses from 46. 90, to 15 the Diameter; that extent will reach from 105 the length, to another Number, and from that to 10 Foot 74 parts, the content.

Example 6. *The Diameter being* 15 *Inches, and the length* 8 *Foot* 75 *parts how many Foot doth it contain?*

As 13. 54,
to 15 inches, the Diameter:
So 8. 75 Foot the length,
to a fourth;
And that fourth,
to 10.74, the length in Feet.

Extend

Extend the Compasses from 3. 54, to 15 the length; that extent will reach from 8. 75 the length, to another Number, and from thence to 10. 74 Foot, the Content in Feet.

II. *By having the Circumference given.*

Example 1. *The Circumference of a Cylinder is* 47 *Inches* 13 *parts; How much thereof in length shall make a Foot solid?*

As 47 13 Inches the Circumference,
to 147. 36:
So 1,
to a fourth Number;
And that,
to 9. 78 Inches, the length of a Foot.

Extend the Compasses from 47. 13 the Circumference, to 147. 36; that extent

extent will reach from 1 to a fourth Number, and from thence to 9 Inches 78 parts, the length of a Foot ſolid.

Example 2. *Having the Circumference of a Cylinder* 3 *Foot* 927 *parts, to find the length of a Foot ſolid thereof in Foot-meaſure.*

As 3. 927 Foot,
to 3. 545;
So 1,
to a fourth Number;
And that,
to 815 parts of a Foot, the length.

Extend the Compaſſes from 3.927, the Circumference, to 3 545; that extent will reach from 1 to ſome other Number; and from thence to 815 parts of a Foot, for the length of a ſolid Foot of that Cylinder.

Example 3. *The Circumference of a Cylinder being* 47 *Inches* 13 *parts, and*

and the length thereof 105 *Inches, How many inches is there in such a Cylinder?*

As 3.545,
to 47.13, the Circumference:
So 105 Inches, the length,
to a fourth Number;
And that,
to 18555, the Content in Inches

Extend the Compasses from 3.545, to 47.13 the Circumference; that extent will reach from 105 the length, to another Number; and from thence to 18555, the number of solid inches in the Cylinder.

Example 4. *The Circumference being* 47 *Inches* 13 *parts, and the length* 105 *Inches (as before); How many solid Foot in that Cylinder?*

As 147.56,
to 47.13 Inches, the Circumfer.
So

So 105 inches, the length,
to a fourth Number;
And that,
to 10 Foot 74 parts, the Content.

Extend the Compasses from 147. 36 to 47. 18, the Circumference, that extent will reach from 105 the length, to another Number; and from that, to 10 Foot 74 parts of a Foot, the solid Content.

Example 5. *Let the length of the Cylinder be 8 Foot 75 parts, and the Circumference 3 Foot 927 parts; How many Foot doth it contain?*

As 3. 545,
to 3. 927 Foot the Circumference:
So 8. 75 Foot the length,
to a fourth Number;
And that,
to 10 Foot 74 parts, the Content.

Extend

Extend the Compaſſes from 3. 545 to 3. 927; the ſame extent will reach from 8.75 the length, to 10: 74 the content in Feet.

Example 6. *Let the Circumference given be* 47 *Inches* 13 *parts, and the length* 8 *Foot* 75 *parts; How many ſolid Foot doth the Cylinder contain?*

As 42. 54,
to 47. 13 Inches the Circumference;
So is 8. 75 Foot, the length,
to a fourth,
And that fourth,
to 10. 74 Foot, the Content.

Extend the Compaſſes from 42. 54 to 47. 13 the Circumference; that extent will reach from 8.75 the length, to another Number, and from thence to 10 Foot 74 parts, the Content of the Cylinder in ſolid Feet.

III. *By having the Side of a Square, equal to the Base or end of a Cylinder.*

Example *Let the Side of a Square, equal to the Base or end of the Cylinder, be* 13 *Inches* 29 *parts, and the length thereof* 105 *Inches; How many Square Feet are contained in that Cylinder?*

As 41. 57,
to 13. 29 Inches, the Side of the Square:
So is 105, the length in Inches,
to a fourth Number;
And that,
to 10 Foot 47 parts, the Content of the Cylinder in Feet and parts.

Extend the Compasses from 41.54. to 13. 29 Inches, the side of a Square equal to the Base of the Cylinder;

that extent will reach from 105 I
ches, the length, to another Numbe
and from thence to 10 Foot 47 part
the Content of the Cylinder in Feet.

II. *Of the* CONE.

A *Cone* is a round Figure, havin
for the Base thereof a Circle, the Sid
whereof riseth from the Circumfe
rence of the Circle round about th
same equally, till it meet in a Poin
just over the Center of the Circle, an
is in the form of a spire Steeple: An
it is thus measured.

Example 1. *Let there be a Con
the Diameter of whose Base is* 10 *Inche
and whose hight is* 12 *Inches; I woul
know how many solid or Cubical Inch
are contained therein.*

The Diameter being 10, the Con
tent of the Circle or Base will b
found to be 78 Inches 54 parts, a
by

by the fifth Example in Chap. 13. of this Book.

The Area of the Baſe being thus found, the Proportion is,

As 3,
to 78. 54 Inches, the Content of the Baſe:
So is 14 Inches, the Height,
to 314 Inches 16 parts of an Inch, for the Content of the Cone in Inches.

Extend the Compaſſes from 3 to 78. 54 the Baſe; that extent will reach from 12 the height, to 314 Inches 16 parts, the Content of the Cone in ſolid Inches.

Example 2. *Let the Diameter of the Baſe be* 12 *Inches, as before, and the length of the Side be* 13 *Inches, How many ſolid Inches is there in this Cone?*

1. Extend the Compaſſes from 1 t
5 Inches, half the Diameter of th
Baſe; that extent will reach fro
5 to 25.
2. Extend the Compaſſes from 1 t
13 the length of the Side; tha
extent will reach from 13 to 169.
3. From this 169, take the 25 before
found, and there remains 144.
4. Upon your Line take half the di-
ſtance between 1 and 144, and you
ſhall find it to be 12, which 12
is the height of the Cone: So the
height being had, you may find the
Content, as in the laſt Example.

III. *Of SPHERICAL BODIES.*

A Spherical Body is ſuch a Body
whoſe Superficies in all the parts of
it are equally diſtant from the Centre
of the Body, as Globes, Bullets, *&c.*

Example

Example 1. *The Circumference of a Globe or Bullet being* 28 *Inches* 28 *parts, to find the length of the Diameter.*

As 22,
to 7:
So is 28. 28, the Circumference,
to 9 Inches, the Diameter.

Extend the Compaſſes from 22 to 7; the ſame extent will reach from 28. 28, the Circumference, to 9 Inches, the length of the Diameter of that Bullet.

Example 2. *The Diameter of a Spherical Body being given, is* 9 *Inches and its Circumference is* 28 *Inches* 28 *parts; How many ſquare Inches is there in the Superficies of that* Spherical *Body?*

As 1,
is to 9 Inches, the Diameter,
So is 28. 28 Inches, the Circumference,
to 244. 5 Inches, the ſuperficial content.

Extend the Compaſſes from 1 to 9 the Diameter; the ſame extent will reach from 28.21, the Circumference, to 254 Inches 5 parts, the ſuperficial Inches in this Spherical Body.

Example 3. *The Diameter of a Spherical Body being* 9 *Inches, how many ſolid Inches are therein contained?*

1. As 1,
is to 9, the Diameter:
So is 9,
to a fourth Number;
And that fourth Number,
to 729, the Cube of the Diameter.

2. As

2. As 9, the Diameter,
to 729, its Cube:
So is 11,
to 891 Inches, the ſolid Content
of the Spherical Body.

Extend the Compaſſes from 1 to 9, that extent will reach to 81, and from 81 to 729, the Cube of the Diameter.——Then Extend the Compaſſes from 9, the Diameter, to 729 its Cube; that extent will reach from 11, to 891 Inches, the ſolid Content of the Spherical Body.

I might here add the manner how to meaſure other kind of Bodies, both Regular and Irregular; as *Ellipſes*, *Parabolas*, *&c.* Alſo of *Priſms*, *Scalena*, *Cones*, *Spheroiades*, *&c.* But theſe being out of the reach of ordinary Artificers, for whoſe ſakes this Treatiſe was chiefly compoſed, I ſhall

ſhall here conclude this Treatiſe of the Uſe of the Line of Proportion, with a ſhort Supplement of Gauging of Veſſels.

CHAP. XIX.

Concerning the

GAUGING of VESSELS

By the Line.

BEfore you can meaſure your Veſſel, to find the Content thereof in Gallons or Parts, you muſt find the Content thereof in Inches; and to effect this, you muſt find the content of two third parts of a Circle, agreeable to the Diameter at the Bung; and one third part of another Circle,

Circle, agreeable to that of the Diameter at the Head: these two added together, and multiplied by the length of the Vessel, that Product will be the Content of that Vessel in Inches.

Examples.
Let there be a Vessel whose
Diameter at Head, 18
Diameter at Bung, 32
Length is 40

And let the Content thereof first in Inches and then in Gallons, be required.

I. *For the two third parts of the Circle at the Bung.*

As 1,
to this universal number [5236]:
So 1024, the square of the Diameter at the Bung 32,
To 536. 166 Inches, which is two third parts of the Content of the Circle at the Bung.

Wherefore, Extend the Compasses from 1, to 5236, the same extent will reach from 1024 (the Square of 32 the Diameter at the Bung) to 536.166 Inches, the Content of two third parts of the Circle at the Bung.

II. *For one third part of the Circle at the Head.*

As 1,
to this general Number [2618.]
So is 324, the Square of the Diameter at the Head 18,
to 84. 823 Inches, which is one third part of the Content of the Circle at the Head.

Wherefore, Extend the Compasses from 1, to 2618; the same extent will reach from 324 (the Square of 18 the Diameter at the Head) to 84. 823 Inches, the Content of one third part of the Diameter at the Head.

III. *For*

III. *For the number of Square-Inches in the Veſſel.*

Add theſe two Numbers — 536. 166
and — 84.823

They make — 620. 989
40

Which multiplied by 40, the length of the Veſſel, produceth — 24839 560

And ſo many ſquare Inches are contained in ſuch a Veſſel, whoſe Diameter at the Head is 18 Inches, at the Bung 32 Inches, and is 40 Inches long.

IV. *For*

IV. *For the Content in Wine or Ale Gallons.*

Divide this Number 24839. 56, by { 231 for Wine / 282 for Ale, } and the Quotients shall tell you the number of Gallons and parts, of a Gallon.

Wine. *gall. parts.*

231)24839. 56(107. 52.

231

1739

1617

1225

1155

706

693

13

Ale.

Ale. *gall. parts.*

282) 24839. 56 (88. 08

2256

2279

2256

2356

2256

100

By this Work you may perceive that this Veſſel containeth { 107 Gallons 53 parts of Wine-meaſure. / 88 Gallons 08 parts of Ale-meaſure.

How to multiply and divide by the Line, is taught in the Second and Third Chapters of this Book, and therefore it were needleſs here to repeat it again: But

I chose rather to do it Arithmetically, for the better Illustration, and for the satisfaction of such as have a delight in Numbers.

How

How to Measure Board, Glass, Timber, Stone, &c.

BY

A Line of Equal Parts,

Drawn from the Centre of a

Two-Foot Joynt-Rule.

ALL Proportions that may be wrought upon a straight Ruler by the Line of Proportion or Numbers, the same may be wrought by a Line of Equal Parts, drawn from the Centre of an Opening Joynt.

And whereas this Line of Equal Parts is numbred from the Centre of

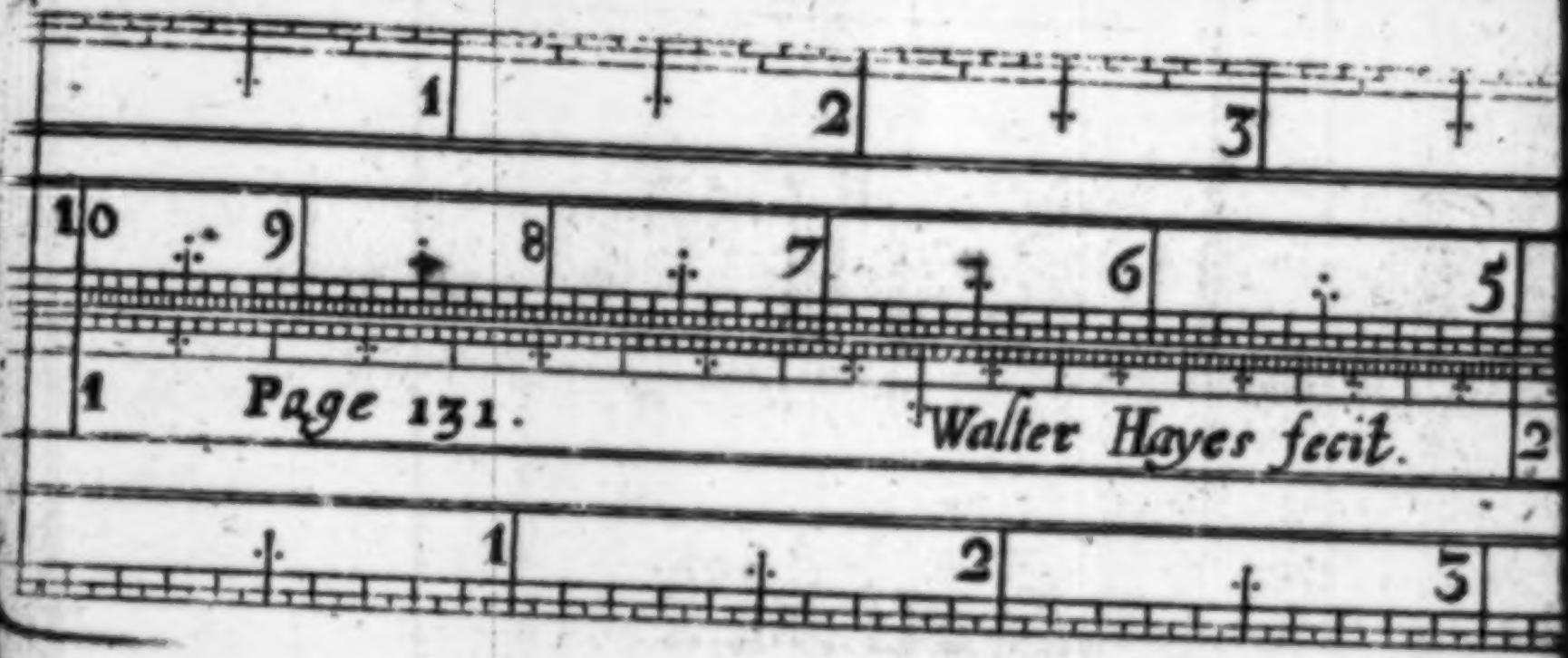
the

the Rule towards the end thereof, by 1, 2, 3, 4, &c. to 10; that these Figures (as in the other Line) do sometimes signifie themselves only, sometimes 10, 20, 30, &c. sometimes 100 200, 300, &c. according to the quality of the Question propounded.

By this Line you may also Multiply, Divide, work the Rule of Proportion, and perform divers things which the Line of Numbers performeth, and some others which that will not; but I shall here only shew you how Board, Glass, Timber, Stone, &c. may be thereby measured; which I shall do in these following Propositions. And,

---

I. *For*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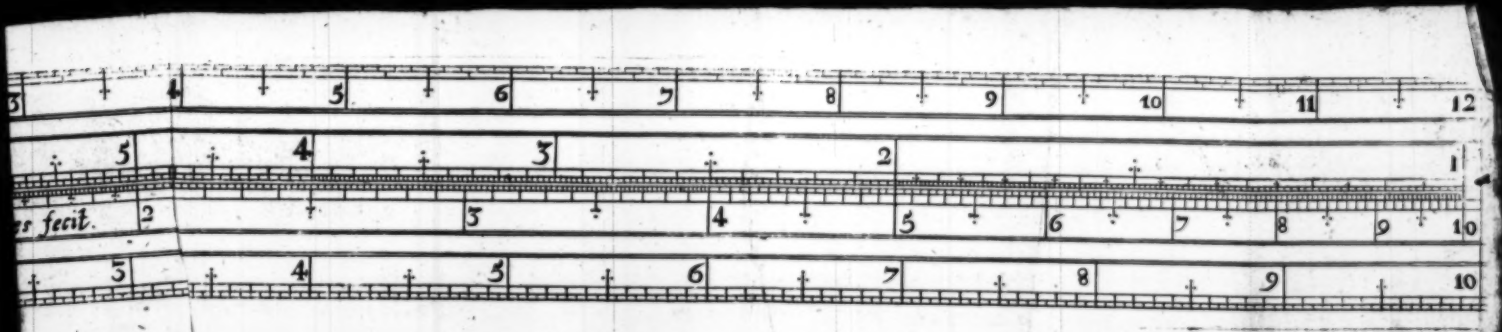
3 4 5 6 7 8 9 10 11 12
5 4 3 2 1
es fecit. 2 3 4 5 6 7 8 9 10
3 4 5 6 7 8 9 10

For SUPERFICIAL-MEASURE, as Board, Glass, &c.

I. In INCH-MEASURE.

PROP. I.

A Plank being 27 Inches broad, and 263 Inches long, how many Square Inches are contained therein?

As 1,
is to 27:
So is 263,
to 7101.

Take in your Compasses the distance from the Centre to 27. (the breadth) upon your Line of Equal parts; with this distance set one Foot in 10 at the end of the Line, and open the Rule till the other Foot fall in 10 on the other Leg of the Rule.

The

The Rule thus ſtanding, take with your Compaſſes the diſtance between 263 on one Leg of the Rule, to 263 on the other Leg; this diſtance will reach from the Centre of the Rule to 7101; and ſo many ſquare Inches are in that Piece.

PROP. 2.

If a Board, or Plank, or piece of Pavement, or of Glaſs, be 20 Inches broad, how much thereof in length ſhall make a Foot ſquare?

As 20,
is to 144:
So 1,
to 7. 2.

Take 144 out of your Line of Equal parts from the Centre, and ſetting one Foot in 20, open the other Leg till the other Compaſs point fall in 20 alſo.

The

The Rule thus ſtanding, take the diſtance between 10 and 10, and that diſtance will reach from the Centre of the Rule to 7 Inches $\frac{2}{10}$ parts of an Inch; and ſo much in length will make a Foot ſquare.

II. *In FOOT-MEASURE:*

PROP. 3:

A Room is 52 Foot broad, and 110. 5 *Foot long; How many ſquare Foot are there in that Room?*

As 52,
is to 1:
So is 110. 5,
to 5746.

Take in your Compaſſes 52 the breadth; with this diſtance open the Ruler in 10, and 10; it ſo reſting, take the diſtance between 110. 5 an

110. 5 on every ſide, that diſtance applied to the Centre of the Rule, will reach to 5746, and ſo many Square Foot is in that Room.

PROP. 4.

A Plank being 2 Foot 25 parts broad, how much in length thereof ſhall make a Foot ſquare?

As 2. 25 the breadth,
is to 1, or 10:
So is 10,
to 44, the length of a Foot.

Take in your Compaſſes the diſtance from the Centre of your Rule to 1; then ſet one Foot in 2. 25. and open the other Leg till the other Compaſs point fall in 2. 25 on the other ſide: the Rule thus ſtanding, take the diſtance between 10 and 10; that diſtance applied from the Centre

tre of the Rule, will reach to 44 parts of a Foot; and ſo much in length will make a Foot.

III. *In* YARD-MEASURE.

PROP. 5:

A Room is hung with Tapeſtry, containing 130 *Yards* 25 *parts in compaſs, and in depth* 5 *Yards* 20 *parts; How many Yards of Tapeſtry is in that Room?*

As 1, to 5. 20:
So is 130. 25, to 677.4:

Take 5.20 in your Compaſſes, and that diſtance put over in 10 and 10; the Rule thus ſtanding, take the diſtancebetween 130.25 and 130. 25 on each Leg of the Rule; that diſtance will reach from the centre of theRule, to 677 Yards 4 tenths of a Yard.

II. *For*

II. *For SOLID-MEASURE, as Timber, Stone, &c. by the Line of Equal Parts.*

I. *In INCH-MEASURE.*

PROP. 1.

A Piece of Timber being 30 *Inches broad*, 21 *Inches* 6 *parts deep, and* 183 *Inches long; How many Foot is contained in that Piece of Timber?*

1. As 1,
   is to 30:
   So is 21. 6,
   to 648.

Take the distance from the Centre to 30; then set one Foot in 10, and open the Rule till the other Compass-point fall in 10 on the other Leg of the

the Rule: Then take the distance between 21. 6 and 21.6, that distance will reach from the Centre of the Rule, to 648, the Content of the Base or end of the Piece of Timber in Inches: Then,

2. As 1728 the number of Inches in a Foot solid,
is to 648, the Content of the Base:
So is 183 Inches, the length,
to 68 Foot 62 parts, the Content in Feet.

Take in your Compasses the distance from the Centre to 1728; with this distance set one Foot in 648, and open the other Leg of the Rule till the other Point of the Compasses fall in 648 on the other Leg; then take in your Compasses the distance from the Centre to 183; with this distance move both Points of the Compasses gently

gently along on both the Lines on either ſide the Rule, till the Compaſs-points reſt upon one and the ſame Number on either Leg; which you ſhall here find them to do at 68. 62 parts; ſo the Piece containeth 68 Foot, and $\frac{62}{100}$ parts of a Foot.

This kind of Work may ſeem troubleſom at firſt; but a little Practice will render it eaſie.

Note, If you take the firſt Number of your Proportion from the Centre of your Rule, you muſt take your third number thence alſo; and then will your number ſought be fonnd, as here in this Example. But if you take your firſt number croſs the Rule, then your third number muſt be ſo taken alſo, and your number ſought muſt be taken from the Centre, as thoſe before were.

PROP.

PROP. 2.

If a Stone be 30 Inches broad, and 21 Inches 6 parts deep; how much in length of that Stone will make a Foot ſquare?

You muſt firſt find the Content of the Baſe, as in the Propoſition, and it will be 648 Inches: Then,

As 648, the Content of the Baſe,
is to 1728, the Inches in a ſolid Foot:
So is 1,
to 2. 67 parts.

Take 1728 in your Compaſſes from the Centre: with that extent open the Rule from 648, to 648: The Rule ſo reſting, take the diſtance between 10 and 10; that diſtance applied to the line from the Centre,

ſhall reach to 2 Inches 67 parts; and ſo much in length will make a Foot ſolid of that Stone or Piece of Timber.

II. *In* FOOT-MEASURE.

PROP. III.

If a Stone or Piece of Timber be 2 *Foot* 50 *parts broad*, 1 *Foot* 80 *parts deep*, *and* 15 *Foot* 25 *parts long*; *How many ſolid Foot doth that Piece contain?*

1. As 1,
   is to 2. 50, the breadth;
   So is 1, 80, the depth,
   to 4. 50, the Content of the Baſe in Feet.

Take 2.50 in your Compaſſes from the Centre; with that extent open the Rule in 10 and 10; then take the diſtance between 1.80 and 1.80, that extent

extent will reach from the Centre of the Rule, to 4 Foot 50 parts, the Content of the Baſe.

2. As 1,
to 4. 50, the Baſe:
So 15. 25, the length,
to 68. 62, the Content in Feet.

Take 4: 50 in your Compaſſes, and thereto open the Rule from 10 to 10, then take the diſtance between 15.25 and 15. 25, that diſtance will reach from the Centre of the Rule, to 68 Foot 62 parts, the Content of the Stone.

PROP. IV.

The breadth being 2 *Foot* 50 *parts, the depth* 1 *Foot* 80 *parts; How much in length thereof will make a ſolid Foot?*

You may find the quantity or con-

tent of the Baſe by the firſt of the laſt Propoſition to be 4 Foot 50 parts Then,

As 4. 50, the Baſe,
is to 1 :
So is 10, or 1 Foot,
to 222 parts.

Open the Compaſſes from the Centre to 1; then ſetting one Foot in 4.50, open the other Leg till the Compaſs point falleth in 4.50 on the other Leg; then take the diſtance between 10 and 10, and that will reach from the Centre to 222; and ſo many parts of a Foot will make a ſolid Foot of that piece of Stone or Timber.

PROP. 5.

To divide a Right Line into any number of Equal Parts, at the firſt opening of the Compaſs.

Let

Let a Line be given to be divided into 6 equal parts: Take the length of the Line given in your Compaſſes then becauſe it is to be divided into 6 parts, put one Foot in 6 on one Leg, and open the other Leg till the other Point fall on 6 on the other Leg. The Rule thus ſtanding, take the diſtance between 1 and 1, that diſtance ſhall divide your given Line into 6 equal parts. The like for any other number of parts whatſoever.

Many other Concluſions may be done by this Line: but I ſhall reſerve them, and divers other Concluſions of the like nature, to a more convenient place.

The Use of the
Line of Proportion
IMPROVED,

By which Board, Glass, Land, Wainscot, Hangings, Pavement, Brickwork, Tyling, Plaistering, *and any other* Superficial; *As also*, Stone, Timber, *and other* Solid Measure, *may be Measured, without the use of* Pen, Ink, Paper, Compasses, *or other* Motion (*as* sliding, *or the like*) *whatsoever, by* Inspection, *onely by looking upon the* Line.

The ARGUMENT.

I Am not ignorant how many have written of the Use of this Line of Proportion since the Invention of Logarithms,

Logarithms, from which Tables this Line is constituted and made; as namely, After Mr. *Gunter*'s first contrivance, Mr. *Wingate* seconded him, in making divers Lines to several Radiusses, thereby to bring it to Extract the Square and Cube Roots, without doubling or trebling, or dividing the distance into two or three parts; but this made a great number of Lines to small purpose; for nothing here could be done without the help of the Compasses.

Again, One *T. Browne*, a Maker of Mathematical Instruments, made it in a serpentine or spiral Line, composed of divers concentrick Circles, thereby to enlarge the divisions; which was the contrivace of one Mr. —— *Milburn* a *Yorkshire* Gentleman, who writ thereof, and communicated his Uses to the aforesaid *Browne*, who (since his death) attributed it to himself:

ſelf: But whoever was the Centriver of it, it is not without inconvenience; for it can in no wiſe be made portable; and beſides (inſtead of Compaſſes) an opening Joynt with thirds muſt be placed to move upon the Centre of the Inſtrument, without which no Proportion can be wrought.

There is yet a third way contrived by which this Line is made very ſerviceable and convenient both for uſe and carriage, and is to be uſed without Compaſſes, and is compoſed of two Lines of one length upon either ſide of two Rulers, to ſlide one by the ſide of the other; the Uſes whereof in the meaſuring of *Board, Glaſs, Timber, Stone, &c.* and in other parts of *Geometry, Aſtronomy, Fortification, Trigonometry, Geography, Navigation, Gauging, Dialling, &c.* together with the Uſes of the Lines of Artificial *Sines* and *Tangents*, in the ſame manner contrived, all upon one Ruler, are large-

ly

ly written upon by Mr. *Seth Partridge*, in a Book of his lately publiſhed, entituled, *The Deſcription and Uſe of the Double Scale of Proportion*; which Book and Inſtrument are both ſold by Mr. *Walter Hays*, at he Sign of the *Croſs-dagers* in *Moor-fields*, near the *Popes head* Tavern:

There is yet another way of diſpoſing of this Line of Proportion, by having one Line of the full length of the Ruler, and another Line of the ſame Radius broken in two parts between 3 and 4; ſo that in working your Compaſſes never go off of the Line. This is one of the beſt Contrivances; but here Compaſſes muſt be uſed.

Theſe are all the Contrivances that I have hitherto ſeen of theſe Lines: That which I here ſpeak of, and will ſhew how to uſe, is onely two Lines of one and the ſame Radius, being ſet

upon a plain Ruler of any length (the larger the better) having the beginning of one Line at the end of the other, the Diviſions of each Line being ſet ſo cloſe together, that if you find any Number upon one of the Lines, you may eaſily ſee what Number ſtands againſt it in the other Line. This is all the Variation: and what this eaſie Contrivance will effect, will appear by the Uſes following.

The Lines are the ſame with the Line of Proportion or Numbers, mentioned and treated of in the former part of this Book; and therefore how to number upon them is ſhewed in the firſt Chapter of this Book, and therefore needs not here again be repeated: Alſo *Multiplication*, *Diviſion*, the *Golden Rule*, *Duplicated* and *Triplicated Proportion*, the *Extraction of Roots*, *&c.* delivered in the ſecond, third, fourth, fifth Chapters, *&c.* as alſo in meaſuring of *Superficies* and

Solids,

Solids and the menſuration of other Figures treated of through the whole Book, theſe Lines thus diſpoſed will effect with Compaſſes: But ſome of thoſe Uſes which they will effect in meaſuring, without the help of Compaſſes, I will here ſhew.

CAUTION

What Meaſure ſoever you meaſure by, let the Integer or Grand Meaſure be divided into 10 or 100 parts (it matters not of what length your Lines of Proportion be, for to them all Meaſures are alike.) Thus, If you meaſure any thing by the Foot, let your Foot be divided into 100 parts: If by the Yard, divide your Yard into 100 parts: If by the Ell, divide that into 100 parts. So likewiſe if by the Perch, Square, *&c.* or by what Meaſure ſoever, let the Grand Meaſure (as I ſaid before) be divided into 100 parts.

CHAP.

CHAP. I.

Of SUPERFICIAL MEASURE.

BY *Superficial Meaſure* is meant all kind of Flat Meaſure, ſuch as is *Board*, *Glaſs*, *Pavement*, *Hangings*, *Plaiſtering*, *Tyling*, *Land-meaſure*, *&c.* And theſe ſeveral things are meaſured by diſtinct Meaſures, as ſome by the Foot, others by the Yard, others again by the Ell, ſome by the Rod, and ſome by the Square: Of all which I ſhall give examples: and,

I. *Of* FOOT-MEASURE.

Example 1. *If a Board be* 1 *Foot* 64 *parts broad, how much in length of that Board will make a Foot ſquare?*

Look

Look upon one of your Lines (it matters not which) for 1 Foot 64 parts, and right againſt it one the other line you ſhall find 61; and ſo many parts of a Foot will make a Foot ſquare of that Board.

Example 2. *A Plank is 3 Foot 50 parts broad, how much thereof in length will make a Foot?*

Find 3 Foot 50 parts upon one Line, and right againſt it one the other line you ſhall find 28 parts and $\frac{4}{7}$, or ſomething more than half a part; and ſo much in length will make a Superficial Foot.

Example 3. *If a Board be 75 parts of a Foot broad, how much thereof in length ſhall make a Foot ſquare?*

Look

Look upon one of your lines for 75, and right against it you ſhall find 1 Foot 33 parts, and ſo much in length makes a ſquare Foot.

Note, If the breadth of any thing given be more than one Foot, then the length of a Foot ſquare muſt be leſs than a Foot, as in the two firſt Examples it was: But if the breadth given be leſs than a Foot (as in this laſt Example) then the length of a Foot ſquare muſt be more than a Foot.

Example 4. *A Pane of Glaſs is 35 parts broad; how much in length makes a Foot?*

Find 35 in one Line, againſt it you ſhall find 2 Foot 85 ½ parts; and ſo much in length makes a ſquare Foot.

Example

Example 5. *A Pane of Glass is 3 Foot broad, how much in length makes a Foot?*

Find 3 Foot in one Line, against it in the other you shall find 33 $\frac{1}{3}$ parts; and so much in length makes a Foot square.

Example 6. *If a Piece of Glass be 1 Foot 98 parts broad, how much in length will make a Foot?*

Look 1 Foot 98 parts in one line, and against it in the other you will find 5 Foot and half a part; and so much in length makes a Foot.

II. *Of* YARD-MEASURE.

Example 1. *A Gallery is Wainscoted 2 Yards 56 parts deep, how much of that length will make a Yard square?*

Seek

Seek 2 Yards 56 parts in one Line, and againſt it in the other you ſhall find 39 parts and ſomewhat more; and ſo many parts of a yard will make a yard ſquare.

Example. 2. *A Room is Wainſcoted 1 Yard 13 parts high; How much in length thereof will make a Yard ſquare?*

Look one Yard 13 parts in one line, againſt it in the other you will find 88 parts and above half a part; and ſo much in length makes a yard ſquare.

Example 3. *If the Frieze about a Room be 62 parts of a Yard broad, how much in length thereof will make a Yard ſquare?*

Find 62 parts in one of your lines, and

and againſt it in the other you ſhall find 1 Yard 61 parts, and ſomewhat more; and ſo much in length makes a Yard ſquare.

Example 4. *There is a Gallery paved with Marble, being 5 Yards 70 parts broad; How much of that in length will make a Yard ſquare?*

Seek 5 yards 70 parts in one line, and againſt it in the other you ſhall find 17 parts and an half; and ſo much in length of that Pavement will make a yard ſquare.

Example 5. *A Parlour being 7 Yards 29 parts broad, hath a Cieling of Fret-work plaiſtered; How much of that breadth will make a Yard ſquare.*

Find 7 Yards 29 parts in one of your

your lines, and right againſt it in the other line you ſhall find 13 parts: and $\frac{7}{10}$ which is above half a part: So that 13 parts and a little more than half a part will make a Yard ſquare of that Cielin.)

Example 6. *A Plaiſterer hath Rendered the inſide of a Wall containing 2 Yards 36 parts in height; How much of that will make a Yard ſquare?*

Find 2 Yards 36 parts in one of your Lines, and right againſt it on the other you ſhall find 42 parts $\frac{3}{10}$ of a part, that is, ſomething more than one third part of a part; and ſo much in length makes a Yard ſquare.

III. *Of MEASURE by the ELL.*

Example 1. *There is a Room hung with Tapeſtry, which is 4 Ells 25 parts*

parts high; How much Tapestry in length will make an Ell square?

Note. Here by Ells we understand Flemish Ells (for by that Measure are Hangings sold); which Ell contains Three quarters of our Yard, that is, 75 parts of our Yard. So that if an Upholster have his Flemish Ell divided into 100 parts, he may measure his Hangings as in the Examples following is shewed.

Here because the Hangings are 4 Ells 25 parts deep, Look for 4 Ells 25 parts in one of your lines, right against which in the other you shall find 23 parts and a half; and so many parts of his Ell will make a Flemish Ell square.

Example 2. *The Embroidery of a Pair*

Pair of Vallens about a Bed is 28 *parts of a Flemiſh Ell deep; How much of that Embroidery in length will make a Flemiſh Ell ſquare?*

Look for 28 parts in one of your lines, and againſt it in the other line you ſhall find 3 Ells and 57 parts of an Ell; and ſo much in length will make an Ell ſquare.

Example 3. *A Gallery being* 3 *Ells* 98 *parts deep, is hung with Arras; How much of that depth will make an Ell ſquare?*

Seek 3 Ells 98 parts in one line, againſt which in the other you ſhall find 25 parts and $\frac{1}{10}$ of a part; and ſo much in length will make an Ell ſquare.

IV. *Of*

IV. *Of MEASURE by the ROD.*

Example 1. *There is a Brick wall which is 75 parts of a Rod high how much in length of that Wall will make a Rod ſquare?*

Note, That all Wall-work is by the Brick-layers meaſured by the Rod, which contains 16 Foot and a half in length: Wherefore, let his Rod, being 16 Foot and an half in length, be divided into 100 equal parts, and then let him work as followeth.

The Wall being 75 parts of a Rod high, Look for 75 parts in one Line, and in the other line right againſt 75 you ſhall find 1 Rod 33 parts of a Rod; and ſo much of that Wall in length is contained in a Square Rod.

Example

Example 2. *A Carpenter hath Railed and paled in a Garden with Pales 52 parts of a Rod high; How much of that Paling ſhall make a Rod ſquare?*

Seek 52 parts in one line, againſt it in the other line you ſhall find 1 Rod 92 parts; and ſo much in length will make a ſquare Rod of that Paling.

Example 3. *A Bricklayer hath made a Shewer to carry Water, the Bottom, Sides, and Arch together contains 1 Rod 64 parts; How much of that Drein or Shewer makes a ſquare Rod?*

Find 1 Rod 64 parts in one of your lines, and right againſt that Number you ſhall find in the other line almoſt 61 parts; and ſo many parts of a Rod in length will make a Rod ſquare.

And

And here note, That though I have here put theſe two laſt Examples, that Paling is not meaſured by the Square Rod, but (let the height thereof be what it will) it is meaſured by the Rod in length: In like manner is Hedging, Ditching, and many other things that are meaſured by the Rod.

Example 4. *If a Piece of Land be 2 Rod 31 parts broad, how much in length thereof ſhall make a Rod Square?*

Seek 2 Rods 31 parts upon one of your Lines, and over againſt it upon the other line you ſhall find 42 parts and about $\frac{2}{3}$ of a part; and ſo much in length makes a ſquare Rod.

Example 5. *A Piece of Land being 80 parts of a Rod broad, how*

how much thereof in length ſhall make a Rod ſquare?

Look for 80 parts in one line, and in the other line oppoſite thereunto you ſhall find 1 Rod 22 parts, and ſo much in length makes a Rod ſquare.

V. *Of* MEASURING *by the* SQUARE.

There are two things principally which are meaſured by the Square, and they are Tyling of Houſes, and Flooring of Rooms; and in this reckoning they account a Square to be 10 Foot every way: So that for this kind of Meaſure divide a Line or Rod of Ten Foot long into 130 parts, and it is fit for the purpoſe.

Example 1. *A Barn, the breadth of the Tyling whereof on both ſides is* 1 *Square* 30 *parts, how much*

much in length of that Tyling will make a ſquare Square?

Find 1 Square 30 parts upon one of your Lines, and right againſt it on the other Line you ſhall find 77 parts almoſt; and ſo much in length of that Tyling will make a ſquare Square.

Example 2. *The Tyling of a Houſe is 76 parts of a Square broad; How much in length thereof will make a ſquare Square?*

Seek 76 parts in one line, and againſt it in the other you ſhall find 1 Square 31 parts and a half almoſt; and ſo much in length will make a ſquare Square, that is, 10 Foot every way, in all 100 Foot.

CHAP. II.

Of SOLID MEASURE.

BY Solid Meaſure is meant ſuch Meaſure as hath Length, Breadth, and Thickneſs; ſuch as Timber, Stone, or the like. But before Timber or Stone can be meaſured, you muſt find the Content of the Square of the Baſe thereof, which is taught by the Problem at the end of the Tenth Chapter: But that being performed by Compaſſes, I will here ſhew how it may be (by theſe Lines thus diſpoſed) performed without; and that ſhall be my firſt propoſition or Example.

Example 1. *Let a piece of Timber or Stone be* 80 *parts of a Foot deep,*

deep, and 3 Foot 75 parts broad; How much in length of that Piece will make a Foot ſquare?

Here (by any of the former Rules of Superficial Meaſure) find at 80 parts broad, how much in length will make a Foot, which you will find to be 1 Foot 25 parts: For,

If you find 80 parts, the depth of the Piece, in one line, againſt it in the other you ſhall find 1 Foot 25 parts. Take 1 Foot 25 parts of your Foot-Rule, and meaſure it along the breadth of the Piece, which is 3 Foot 75 parts, and ſee how often it is contained therein, which you ſhall find to be three times; wherefore, you may conclude, that the Square of the Baſe of that Piece of Timber whoſe depth is 80 parts, and whoſe breadth is 3 Foot 75 parts, is juſt 3 Foot.

Now the Square of the Baſe of the

piece being thus obtained, you may find the length of a Foot ſolid thereof in this manner.

Example 2. *Let the Square of the Baſe of a Piece of Timber or Stone be 3 Foot; How much in length of that Piece will make a Foot ſolid?*

Look for 3 Foot in one of your lines, and in the other right againſt it you ſhall find 33 parts and $\frac{1}{3}$ part of a part; and ſo much in length will make a Foot ſolid.

Example 3. *Let a Piece of Stone or Timber be 2 Foot 50 parts broad, and 50 parts deep; How much of that Stone in length ſhall make a ſolid Foot?*

By any of the ways before preſcribed, you ſhall find that the depth of your

your Stone being 50 parts, it will require 2 Foot in length thereof to make a Foot ſquare: Wherefore, meaſure how often you can find 2 Foot in the breadth of your Solid, which you can find onely once, and 50 parts more, which is one quarter of two Foot: Wherefore, the Square of this Solid contains 1 Foot 25 parts. Wherefore, Look in one of your lines for 1 Foot 25 parts, and right againſt it you ſhall find 80 parts; and ſo much in length will make a Foot ſolid.

Example 4. *The Square of the Baſe of any Regular Solid being given, together with the length of the ſame Solid; To find how many ſolid Feet are contained in the ſame.*

Let the forementioned Solid ſerve for this Example alſo, whoſe length

was 32 Foot: We found that the Square of the Baſe was 1 Foot 25 parts, and that 80 parts in length would make one ſolid Foot: Wherefore, take 80 parts of your Rule, and run it along the Piece ſo often as you can, which you ſhall find to be 43 and 60 parts, which is juſt three Quarters; ſo that in this Piece of Timber there is 43 Foot and three Quarters.

I might add many more Examples of this kind, and ſome to other purpoſes; but theſe are ſufficient for the purpoſe intended. And ſo I ſhall conclude this Treatiſe, leaving the farther Practice thereof to your ſelf: For,

Uſus optimus Magiſter.

CAHP.

CHAP. III.
Of CIRCULAR-MEASURE.

By having either the Circumference or Diameter of any Circle given, thereby to find the Side of a Square equal to the ſame Circle; or the Side of a Square that may be inſcribed within the ſame Circle.

IN the Thirteenth Chapter of this Book you have ſix Examples by having the Circumference or Diameter of any Circle given, thereby to find the Side of a Square equal to the Superficial Content, *&c.* But I have ſeen upon ſome Two-foot Rules, Lines to effect this thing, by onely opening the Compaſſes to the diſtance given

given upon one Line, and applying the ſame to ſome of the other Scales: One of thoſe Scales is noted at the end thereof with *C*, ſignifying the Circumference of any Circle; the other with *D*, ſignifying the Diameter; the other with *S. E*, ſignifying Square Equal to the Circle, the other with *S. W.* ſignifying Square Within.

Example. So that if you ſhould have given you the Diameter of a Circle, being 15 inches; out of the Line noted with *D*, take 15 inches; apply that diſtance to the Line noted with *C*, it will reach to 47 Inches and $\frac{13}{100}$ parts of an inch: and ſo much is the Circumference of that Circle.

Again, The Diameter being 15 inches, as before, take that Diſtance out of the Line *D*, and it will reach upon the Line *S. E*, to 13 inches $\frac{29}{100}$ parts: and that ſhall be the ſide of a Square equal to the Circle whoſe Diameter is 15 inches.

Again,

Again, The Diameter being 15 Inches, if you take that Diſtance out of the line noted with *D*, it will reach upon the line *S. W*, to 10 Inches $\frac{69}{100}$ parts of an Inch: and that is the length of the Side of the greateſt Square that can be drawn within that Circle whoſe Diameter is 15 Inches.

The like may be done if the Circumference were given, by taking the Circumference thereof out of the line noted with *C*, and applying it to the other Scales.

This I thought convenient to add here, becauſe ſometimes theſe lines are put upon Two-foot Rules.

FINIS.

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